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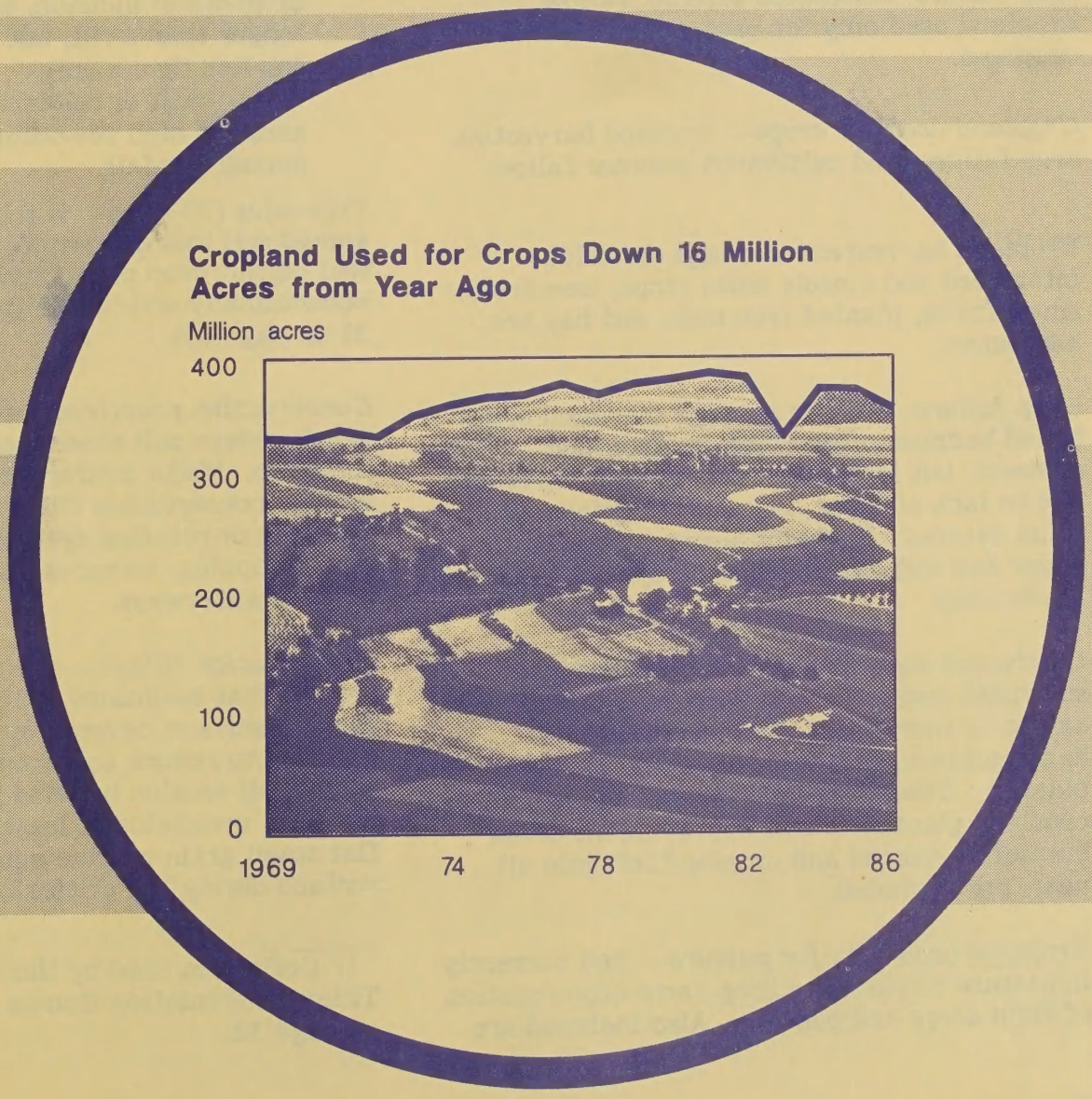
Cropland, Water, and Conservation

Situation and Outlook Report



INTRODUCTION

This report presents reference information on cropland, irrigation water use, and soil conservation. Particular attention is given to the new programs included in the Food Security Act of 1985. Future reports will concentrate on updating the situation and outlook and focus on specific issues.

The Nation's agricultural output depends heavily upon the acreage devoted to crops, the inherent productivity of the soil, and the amount of water and other inputs applied. Changes in cost-price relationships, competing uses for land and water, and Federal farm programs cause adjustments in cropland, water use, and soil conservation.

Terms Used

Cropland--consists of cropland harvested, crop failure, cultivated summer fallow, cropland used only for pasture, and idle cropland.

Cropland used for crops--cropland harvested, crop failure, and cultivated summer fallow.

Cropland harvested--acreage on which intertilled and closely sown crops, tree fruits, small fruits, planted tree nuts, and hay are harvested.

Crop failure--mainly acreage on which crops failed because of weather, insects, and diseases, but includes some land not harvested due to lack of labor, low market prices, or other factors. Excludes acreage planted to cover and soil improvement crops not intended for harvest.

Cultivated summer fallow--cropland in subhumid regions of the West cultivated for a season or more to control weeds and accumulate moisture before small grains are planted. Other types of fallow, such as cropland planted to soil improvement crops but not harvested and cropland left idle all year, are excluded.

Cropland used only for pasture--land currently in pasture as part of a long-term crop rotation of field crops and pasture. Also included are cropland which is pastured rather than harvested for crop production and some land used for pasture that could have been cropped without additional improvement.

Idle cropland--land in cover and soil improvement crops and completely idle cropland. Includes acreage diverted from crops to soil conserving uses under Federal farm programs.

Erosion--the process in which water or wind moves soil from one location to another. Types of erosion are:

Sheet and rill--when rainfall or irrigation water runoff causes a general washing away of a thin uniform sheet of soil, or the removal of soil in many small channels or incisions.

Gully--channelling or incisions cut by concentrated water runoff after heavy rains.

Ephemeral--a water-induced short-lived or seasonal incision, wider, deeper and longer than a rill, but shallower and smaller than a gully.

Wind--dust or sediment carried by wind in areas of high prevailing winds or low annual rainfall.

Tolerance (T) value--is the maximum rate of annual soil loss in tons per acre per year that will permit crop productivity to be sustained economically and indefinitely (see reference 21 on page 33).

Conservation practices--methods or devices which reduce soil erosion or retain soil moisture. Major conservation practices include conservation tillage (defined below), cropping or rotation systems, contour farming, strip-cropping, terraces, diversions, and grassed waterways.

Conservation tillage--any tillage and planting system that maintains at least 30 percent of the soil surface covered by crop residue after planting to reduce soil erosion by water; or, where soil erosion by wind is the primary concern, maintains at least 1,000 pounds of flat small grain residue equivalent on the surface during the critical erosion period. 1/

1/ Definition used by the Conservation Tillage Information Center. See reference 4 on page 32.

No-till is the most restrictive or soil conserving form of conservation tillage. Other conservation tillage practices include ridge-till, strip-till, reduced-till, and mulch-till.

Conventional tillage--tillage that inverts the soil by plowing or which otherwise leaves less than the minimum residue after planting required to qualify as conservation tillage.

Irrigated farms--farms with any agricultural land irrigated in the specific calendar year. The acreage irrigated may vary from a very small portion of the total acreage in the farm to irrigation of all agricultural land in the farm.

Irrigated land--same definition as acres irrigated (see below).

Acre foot--the quantity of water required to cover 1 acre to a depth of 1 foot. This is equivalent to 43,560 cubic feet or 325,851 gallons.

Acres irrigated--acreage of agricultural land to which water is artificially applied by controlled means. Land flooded during high water periods is included as irrigated land only if the water is diverted to the land by dams, canals, or other works.

Dryland farming--the practice of crop production in low rainfall areas without irrigation by using moisture-conserving techniques, such as mulches and fallowing; also called dry farming.

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SUMMARY

Cropland used for crops--harvested, failed, and summer fallowed--is expected to total 356 million acres in 1986, down 16 million from last year. In 1986, farmers diverted from production 18 million more acres than a year ago. Peak acreage of cropland used for crops was 387 million in 1981.

The reduction in cropland harvested from 1985 to 1986 continues a trend that began in 1982. Largest reductions are expected in the Corn Belt (down 5 percent) and the Southern Plains (down 11 percent). Despite the decline in harvested acreage, output per acre has increased. The index of crop production per acre reached a high of 119 in 1985 (1977=100), 7 points above the 1984 level. The previous high was 116 in 1982.

The Conservation Reserve Program (CRP) for idling highly erodible cropland through 10-year contracts began in early 1986 when 3.8 million acres were enrolled, and expanded in August to nearly 9 million. Largest enrollments have been in the Mountain and Southern and Northern Plains regions, which account for 60 percent of all CRP acreage. The 1987 goal is to increase the program to at least 15 million acres, with 40-45 million enrolled by 1990. Several other provisions in the Food Security Act of 1985, including the "sodbuster" and "swampbuster" provisions, are designed to discourage conversions of highly erodible lands and wetlands to crop use.

Just under 45 million acres were irrigated in 1984, the latest year for which data are available. This represents a decline from the peak of 51 million acres in 1978.

More than 82 million acre feet of water were applied in 1984. Approximately 96 percent of all ground water and 99 percent of all surface water used for irrigation were applied in the 20 principal irrigated States. Irrigators in California accounted for approximately 29 percent of all water used in agriculture. Use was also relatively high in Texas, Nebraska, Idaho, and Colorado.

Irrigators obtained about equal amounts of water from ground and surface sources in 1984. Small quantities of recycled sewage effluent were also used. The principal means for delivering water were on-farm ground water pumps (44 percent), on-farm surface water supplies (12 percent), and off-farm suppliers (44 percent).

In 1982, 12 percent of all farms used irrigation. All rice grown was irrigated, along with 70 percent of the orchards, more than half of all vegetables, and about a third of the cotton. In contrast, only small percentages of field grain crops were irrigated.

Cropland soil erosion continues to cause major damage both on and off farms. In 1982, 3.1 billion tons of soil eroded on cropland due to sheet, rill, and wind erosion. Productivity on nearly one-half of the Nation's cropland is being damaged by wind and water erosion. Annual off-farm damages due to cropland erosion exceed on-farm damages.

In recent years, USDA has spent about $1 billion annually--2 percent of its budget--for soil, water, and forest conservation programs. Expenditures on erosion control alone accounted for 41-45 percent of the total.

The need for conservation practices varies greatly with local conditions. Soil conservation practices were used on about 38 percent of the Nation's farms with cropland in 1983. Conservation tillage is now used on about 30 percent of planted cropland.

1986–87 OUTLOOK

Cropland used for crops is expected to total 356 million acres in 1986, 16 million below last year and 31 million below the 387 million peak in 1981. Farmers diverted 49 million acres from production, 18 million more than in 1985.

Harvested cropland is estimated at 317 million acres in 1986 compared to 334 million in 1985. Largest reductions are anticipated in the Corn Belt, Southern Plains, and the Southeast. Crop failure is estimated at 7 million acres nationwide, about the same as last year, but with highest rates in the Southeast and Southern Plains. Another 32 million acres are expected to be summer fallowed.

The downward trend in crop acreage that started in 1982 will continue into 1987. Record or near–record U.S. and world supplies of major crops, coupled with only modest growth in demand in 1987, will substantially depress average commodity prices to levels below those for fiscal 1986. With narrowing profit margins but with 1987 target prices still at 1986 levels, participation in 1987 commodity programs should increase as more producers rely on deficiency payments to offset the expected lower net returns to production.

Several provisions of the 1987 wheat, feed grains, and upland cotton programs have been announced. Wheat producers in the program must divert 27.5 percent of their base acreage, up from 25 percent in 1986. The feed grains program specifies a 20–percent acreage reduction, down from 25 percent in 1986. Acreage reduction for the upland cotton program is 25 percent, the same as last year.

In the third round of bidding this August, 5.1 million acres of highly erodible cropland were enrolled in the Conservation Reserve Program (CRP), bringing total enrolled acreage to 8.9 million. Further calls for enrollment will likely be made to reach the 1987 goal of at least 15 million acres in the program.

More cropland planted to permanent vegetation in the CRP and to soil–conserving uses under annual commodity programs should reduce the volume of soil erosion in 1987. Additional acres in conservation tillage will further reduce erosion. Although the 1985 Food Security Act does not require landowners to implement conservation plans on highly erodible land until 1990, some may adopt them earlier. Also, increased emphasis on targeting public assistance to specific areas and farms with most severe erosion problems will buy more erosion control and permit cost–effective use of public expenditures. On the other hand, the farmer's cost of adopting conservation practices will increase if Federal cost–share funds are eliminated.

Drought in several portions of the southern States led to higher usage of irrigation water in 1986 and may encourage installation of additional irrigation systems to supplement precipitation. Favorable precipitation reduced irrigation requirements in the Corn Belt and Northern Plains. While lower energy costs in 1987 will reduce pumping costs, the amount and distribution of precipitation will be key factors affecting the number of acres irrigated and the volume of water applied, even with reduced plantings.

Competition for control over existing water resources in the West, including those used for irrigation, is growing. Over the longer–term, greater attention will be given to managing the demand for water rather than developing new supplies. More emphasis will be given to managing or conserving water by adopting more efficient technology, controlling use at both the farm and State levels, and transferring water to higher–valued uses.

CROPLAND

Cropland Used for Crops Down 16 Million Acres in 1986

Cropland used for crops in 1986 is estimated at 356 million acres, down 16 million (4 percent) from last year's 372 million (table 1). The decline is largely due to farmers diverting nearly 49 million acres from production, 18 million more than in 1985. Acreage was highest in 1981 when 387 million were used for crops.

Table 1.--Major uses of cropland, United States[1/]

Cropland	1969	1974	1978	1982	1983	1984	1985	1986[2/]
	Million acres							
Cropland used for crops	333	361	369	383	333	373	372	356
Cropland harvested	286	322	330	347	294	337	334	317
Cropland failure	6	8	7	5	5	6	7	7
Cultivated summer fallow	41	31	32	31	34	30	31	32
Idle cropland	51	21	26	21	3/	3/	3/	3/
Cropland pasture	88	83	76	65	3/	3/	3/	3/
Total cropland	472	465	471	469	3/	3/	3/	3/

1/ Includes the 48 conterminous States. 2/ Preliminary. 3/ Estimated only for years coinciding with a Census of Agriculture.

Source: (1,2,3,4,10,13).

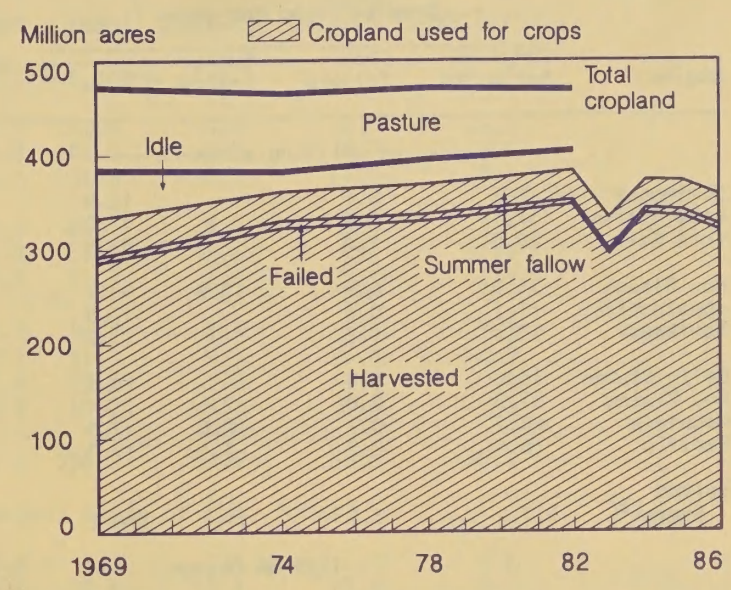
Planted area of the 19 principal crops in 1986 totaled 326 million acres (15).[1/] Based on farmers' intentions, harvested acreage of principal crops is expected to be nearly 314 million. Adding an estimated 12 million acres of minor crops harvested, total harvested area should approach 326 million acres, 9 million of which are estimated to be double cropped. So, cropland harvested in 1986 is expected to total 317 million acres. Because harvesting is still underway in many areas, acreage and failure may change from currently estimated levels. Acreage of cropland harvested peaked at 351 million in 1981 (10).

Nearly 32 million acres were summer fallowed in 1986, up only slightly from last year's 31 million. Summer fallow acreage tends to increase when farmers divert more cropland from production. Acreage reached 41 million in 1969 when 58 million acres of cropland were diverted. Fallow acreage was also somewhat higher in 1983 with the Payment-in-Kind (PIK) and other programs.

Cropland failure in 1986 is estimated at nearly 7 million acres. In recent decades, crops have failed on about 2 percent of the planted acreage.

1/ Numbers in parentheses cite references at the end of this section.

Figure 1
Major Uses of U.S. Cropland



Total cropland acreage has been rather stable (table 1). Uses within the cropland base principally fluctuated with changes in cost-price relationships and farmers' participation in acreage adjustment programs.

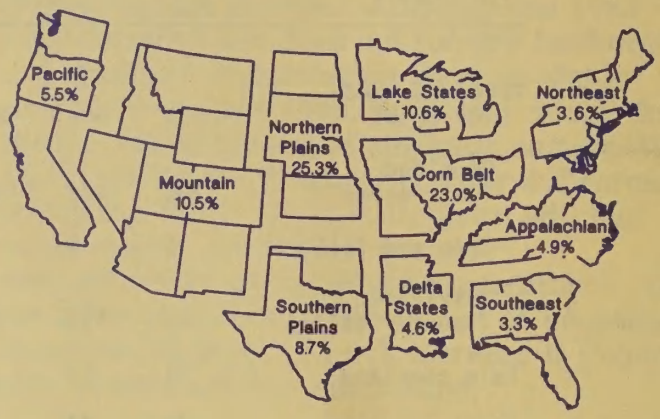
Northern Plains and Corn Belt Each Have One-fourth of 1986 Acreage

The largest concentrations of cropland used for crops are in the Northern Plains and the Corn Belt with 90.1 and 81.8 million acres,

respectively (table 2). Each region accounted for nearly one-fourth of the U.S. total. Another 9–11 percent is in each of the Lake States, Southern Plains, and Mountain regions. Shares in other regions are substantially lower, ranging from 3 to 5 percent.

Cropland concentration is further revealed by comparing regional shares of cropland used for crops with shares of all agricultural land.[2/] Together, the Corn Belt and Northern Plains had 48 percent of all crop acres but only 27 percent of the agricultural land. In contrast, the Southern Plains and Mountain regions jointly had only 19 percent of all crop acres, but nearly 50 percent of all agricultural land.

Figure 2
Northern Plains Has Largest Share of Cropland Used for Crops



Cropland used for crops accounted for one-third of all agricultural land in the United States (table 2). Percentages were highest in the Lake States (73 percent) and the Corn Belt (71 percent). They were lowest in the Southern Plains (17 percent), Mountain (11 percent), and Pacific (25 percent) regions.

2/ Agricultural land includes all cropland, grassland pasture and range, farmsteads, and farm roads.

Table 2.--Cropland used for crops by region in 1986 and 1985–86 change

Region	Cropland used for crops 1/				Share of all cropland used for crops	Share of all agricultural land 2/	Cropland as percent of agricultural land
	Cropland harvested	Crop failure	Summer fallow	Total			
	Million acres				Percent		
Northeast	12.8	0.1	-	12.9	3.6	1.8	64.4
Lake States	37.1	0.4	-	37.5	10.5	4.8	72.8
Corn Belt	80.8	1.0	-	81.8	23.0	10.8	71.0
No. Plains	73.3	0.9	15.9	90.1	25.3	16.6	50.7
Appalachian	17.1	0.4	-	17.5	4.9	3.5	46.7
Southeast	10.5	1.2	-	11.7	3.3	2.9	37.5
Delta States	16.0	0.4	-	16.4	4.6	3.1	49.7
So. Plains	27.0	2.0	2.1	31.1	8.8	16.6	17.5
Mountain	26.2	0.7	10.6	37.5	10.5	32.6	10.8
Pacific	16.4	0.2	3.1	19.7	5.5	7.3	25.2
United States 3/	317.2	7.2	31.7	356.1	100.0	100.0	33.2
	1985–86 Change						
Northeast	-0.4	-	-	-0.5	0.1		
Lake States	-1.2	-0.3	-	-1.5	-		
Corn Belt	-3.9	0.4	-	-3.5	0.3		
No. Plains	-1.9	-0.5	0.1	-2.3	0.5		
Appalachian	-1.4	0.3	-	-1.2	-0.1		
Southeast	-2.3	0.8	-	-1.6	-0.6		
Delta States	-1.5	0.1	-	-1.4	-0.3		
So. Plains	-3.5	0.3	0.2	-2.9	-		
Mountain	1.0	-1.2	0.3	0.1	0.2		
Pacific	-1.2	0.1	0.1	-1.0	-0.1		
United States 3/	-16.4	-0.1	0.7	-15.8	-		

1/ Preliminary. Based on farmers' intentions to harvest. 2/ Agricultural land includes all cropland, grassland pasture and range, farmsteads, and farm roads (1982 data). 3/ Includes the 48 conterminous States. Fewer than 200,000 acres were used for crops in Alaska and Hawaii. Because of rounding, regional acres may not sum to U.S. totals. Source: (10,13).

Each of the latter has sizable acreages of pasture and range, particularly the Mountain region.

Regional acreages of cropland harvested in 1986 closely parallel those for cropland used for crops. Crop failure on about 2 million acres in the Southern Plains represents 7 percent of the region's planted acreage of principal crops. The failure rate may approach 11 percent in the Southeast where drought has been serious for several months, 3 percent in the Mountain region, and 2 percent or less in other areas. Summer fallowing is most prevalent in the Northern Plains and Mountain regions, which together account for 84 percent of the U.S. acreage in 1986.

Considering the 1985-86 changes, reductions in planted and harvested acreage reflect farmers' decisions to place an additional 18.2 million acres of cropland in acreage adjustment programs in 1986.[3/] Harvested acreage is down in all areas except the Mountain region (table 2). A 1-million-acre increase is expected there because farmers intend to harvest a larger percentage of planted acreage than in 1985. Largest reductions in harvested acreage are anticipated in the Corn Belt (down 5 percent), the Southern Plains (down 11 percent), and the Southeast (down 18 percent). Even with reduced plantings, increases in crop failure are expected in several regions. Modest increases in acreage summer fallowed are expected.

Regional Shifts in Acreage

Acreage of cropland used for crops in 1986 is 31 million below the latest peak which

3/ Acreage diverted is later shown in tables 7 and 8.

Table 3.--Cropland used for crops and change in acreage by region

Region	1981	1983	1985	1986[1/]	Change 1981-83	Change 1983-85	Change 1981-86
	Million acres						
Northeast	13.6	12.8	13.3	12.9	-0.8	0.5	-0.7
Lake States	40.3	33.8	39.0	37.5	-6.5	5.2	-2.8
Corn Belt	87.5	71.4	85.3	81.8	-16.1	13.9	-5.7
Northern Plains	93.5	84.0	92.4	90.1	-9.5	8.4	-3.4
Appalachian	19.4	16.6	18.7	17.5	-2.8	2.1	-1.9
Southeast	14.8	13.2	13.3	11.7	-1.6	0.1	-3.1
Delta States	19.6	16.2	17.7	16.4	-3.4	1.5	-3.2
Southern Plains	38.0	28.7	34.1	31.1	-9.3	5.4	-6.9
Mountain	38.1	36.3	37.4	37.5	-1.8	1.1	-0.6
Pacific	22.2	20.1	20.7	19.7	-2.1	0.6	-2.5
United States[2/]	387.0	333.1	371.9	356.1	-53.9	38.8	-30.9
	Percent share of U.S. total						
Northeast	3.5	3.8	3.6	3.6	1.5	1.3	2.6
Lake States	10.4	10.2	10.5	10.5	12.1	13.4	9.1
Corn Belt	22.6	21.4	22.9	23.0	29.9	35.8	18.5
Northern Plains	24.2	25.2	24.8	25.3	17.6	21.6	11.0
Applachian	5.0	5.0	5.0	4.9	5.2	5.4	6.1
Southeast	3.8	4.0	3.6	3.3	3.0	0.3	10.0
Delta States	5.1	4.9	4.8	4.6	6.3	3.9	10.4
Southern Plains	9.8	8.6	9.2	8.8	17.2	13.9	22.3
Mountain	9.8	10.9	10.0	10.5	3.3	2.8	1.9
Pacific	5.8	6.0	5.6	5.5	3.9	1.6	8.1
United States[2/]	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Preliminary. 2/ Includes the 48 conterminous States. Fewer than 200,000 acres were used for crops in Alaska and Hawaii. Because of rounding, regional estimates may not sum to U.S. totals.

Source: (10,13).

occurred in 1981 (table 3).[4/] Reductions are largest in the Southern Plains, the Corn Belt, and the Northern Plains. Adjustments in these and other regions are closely related to cropland acreage adjustment programs. No cropland was diverted in 1981, but 78 million acres were in 1983. Farmers enrolled 32 million acres of the corn base acreage and 30 million acres of wheat in PIK and other programs. Almost 30 percent of the 54-million-acre drop in crop acres between 1981 and 1983 occurred in the Corn Belt, while the Northern and Southern Plains each accounted for about 17 percent (table 3).

4/ Acreage also peaked at 387 million in 1949. Regional shifts since 1949 have been discussed earlier (6).

U.S. cropland used for crops increased by nearly 39 million from 1983 to 1985. By 1985, the corn base acreage in acreage adjustment programs was down to 5.4 million, but the wheat acreage was still relatively high at nearly 19 million. As a consequence, cropland came back into production more quickly in the Corn Belt (36 percent of the increase) and, to a lesser extent, in the Northern Plains (22 percent). The Southern Plains, however, had only 14 percent of the increase, largely because producers there still had sizable amounts of wheat acres in acreage adjustment programs.

Farmers diverting cropland under annual programs can quickly return it to production. Adding annually diverted acreage to cropland

Table 4.--"Readily usable" cropland and change in acreage by region[1/]

Region	1981	1983	1985	1986[2/]	Change 1981-83	Change 1983-85	Change 1981-86
	Million acres						
Northeast	13.6	13.8	13.5	13.3	0.2	-0.3	-0.3
Lake States	40.3	41.8	41.0	41.6	1.5	-0.8	1.3
Corn Belt	87.5	89.3	89.2	90.8	1.8	-0.1	3.3
Northern Plains	93.5	105.0	102.5	104.4	11.5	-2.5	10.9
Appalachian	19.4	19.2	19.3	19.0	-0.2	0.1	-0.4
Southeast	14.8	15.5	14.0	13.1	0.7	-1.5	-1.7
Delta States	19.6	19.7	19.6	18.7	0.1	-0.1	-0.9
Southern Plains	38.0	41.5	40.0	38.6	3.5	-1.5	0.6
Mountain	38.1	42.4	41.4	43.3	4.3	-1.0	5.2
Pacific	22.2	23.0	22.3	22.1	0.8	-0.7	-0.1
United States[3/]	387.0	411.2	402.7	405.0	24.2	-8.5	18.0
	Percent share of U.S. total						
Northeast	3.5	3.3	3.3	3.3			
Lake States	10.4	10.2	10.2	10.3			
Corn Belt	22.6	21.7	22.1	22.4			
Northern Plains	24.2	25.5	25.5	25.8			
Applachian	5.0	4.7	4.8	4.7			
Southeast	3.8	3.8	3.5	3.2			
Delta States	5.1	4.8	4.9	4.7			
Southern Plains	9.8	10.1	9.9	9.5			
Mountain	9.8	10.3	10.3	10.5			
Pacific	5.8	5.6	5.5	5.4			
United States[3/]	100.0	100.0	100.0	100.0			

1/ Includes cropland used for crops plus cropland diverted from production with acreage reduction programs. 2/ Preliminary. 3/ Includes the 48 conterminous States. Fewer than 200,000 acres were used for crops in Alaska and Hawaii. Because of rounding, regional estimates may not sum to U.S. totals.

Source: (8,10,13).

used for crops provides a measure of "readily usable" cropland (table 4). Although this procedure may result in a small amount of double counting of diverted acres and cultivated summer fallow, it shows substantially different regional adjustments compared with the pattern for cropland used for crops. Less fluctuation occurs in regional and national acreages over time. During 1981 to 1983, readily usable acres increased in all regions, except the Appalachian (table 4). Some cropland pasture and other land uses were likely converted to crop use. The 11.5-million-acre expansion in the Northern Plains was particularly large. Between 1983 and 1985, all regional acreages declined, except in the Appalachian, and the U.S. total was down 8.5 million acres. Some diverted cropland was not returned to production.

The Nation's readily usable acreage increased 18 million during 1981-86 (table 4). Largest regional increases occurred in the Corn Belt, Northern Plains, and the Mountain regions. Largest declines were in the Southeast and the Delta States where some cropland was shifted to other uses.

Acreage of Major Crops Lower

Harvested acreage for all major crops will be lower in 1986. The 16.4-million-acre reduction in cropland harvested from 1985 to 1986 continues a trend begun in 1982 (table 5).

About 37 percent of the 1985-86 reduction was due to 6.1 million fewer acres of corn. As expected, largest reductions occurred in the principal producing regions. Nationwide, farmers placed an additional 8.6 million acres of corn base in acreage reduction programs, increasing from 5.4 million to 14 million. But, the increase in corn acreage diverted was partially offset by larger plantings by some farmers not participating in the programs.

Sorghum acreage was down 3.2 million, with fewer acres in all producing regions. Wheat was off 3.8 million acres partly because farmers enrolled an additional 2 million base acres in 1986 programs. Soybean increases in the Corn Belt and Northern Plains were more than offset by fewer acres in other regions, so that nationally the decline was 1.8 million acres. The 800,000 fewer acres of cotton in the Southern Plains represented more than half the 1.4-million-acre reduction at the U.S. level.

Comparisons between 1986 and 1981 bear noting. U.S. wheat acreage in 1986, at 60.9 million, was nearly 20 million acres and 25 percent below the 1981 level (table 6). The largest decline was in the Northern Plains--5.2 million acres--but the largest percentage decline was in the Corn Belt where wheat decreased nearly 60 percent from 7.7 to 3.2 million acres. Soybean acreage increased

Table 5.--Change in harvested acreage of major crops by region, 1981-86 and 1985-86[1/]

Region	1981-86						1985-86					
	Corn	Sorghum	Wheat	Soybeans	Cotton	All cropland harvested	Corn	Sorghum	Wheat	Soybeans	Cotton	All cropland harvested
	Million acres											
Northeast	-0.4	-	-0.1	-	-	-0.7	-0.2	-	-	-	-	-0.4
Lake States	-1.8	-	-0.6	0.4	-	-2.8	-1.1	-	0.2	-0.2	-	-1.2
Corn Belt	-2.6	0.3	-4.5	0.8	-	-6.0	-3.3	-0.6	-0.6	0.3	-	-3.9
No. Plains	0.3	-0.2	-5.2	1.4	-	-4.0	-0.7	-0.6	-1.1	0.5	-	-1.9
Appalachian	-0.4	0.1	-1.2	-1.7	-	-2.1	-0.3	-0.4	-0.4	-0.3	-0.1	-1.4
Southeast	-1.1	-	-0.9	-3.6	-	-3.8	-0.3	-0.2	-0.6	-1.5	-	-2.3
Delta States	0.5	0.7	-1.3	-3.4	-0.4	-3.3	0.3	-0.8	0.1	-0.6	-0.1	-1.5
So. Plains	0.2	-0.8	-2.9	-0.3	-3.6	-7.3	-0.2	-0.4	-1.4	-	-0.8	-3.5
Mountain	-0.1	-0.2	-1.5	-	-0.4	-1.6	-0.1	-0.1	0.3	-	-0.1	1.0
Pacific	-	-0.1	-1.5	-	-0.5	-2.3	-0.1	-	-0.5	-	-0.3	-1.2
United States[2/]	-5.5	-0.2	-19.7	-6.4	-4.9	-34.0	-6.1	-3.2	-3.8	-1.8	-1.4	-16.4

- = None or fewer than 100,000 acres.

1/ Corn and sorghum for grain. All 1986 acreages based on harvest intentions. Changes developed from unrounded estimates. 2/ Includes the 48 conterminous States. Because of rounding, regional acres may not sum to U.S. totals.

Source: (14,16).

Table 6.--Harvested acreage of major crops by region[1/]

Region	Corn			Sorghum			Wheat			Soybeans			Cotton		
	1981	1985	1986	1981	1985	1986	1981	1985	1986	1981	1985	1986	1981	1985	1986
	Million acres														
Northeast	3.2	3.0	2.9	-	-	-	0.6	0.6	0.6	0.9	0.9	0.9	-	-	-
Lake States	13.1	12.4	11.3	-	-	-	4.5	3.6	3.8	5.8	6.4	6.2	-	-	-
Corn Belt	36.9	37.6	34.2	1.0	1.9	1.3	7.7	3.8	3.2	30.2	30.7	31.0	0.2	0.2	0.2
No. Plains	11.1	12.1	11.4	6.1	6.5	5.8	30.4	26.3	25.2	4.6	5.5	6.0	-	-	-
Appalachian	4.7	4.6	4.3	0.2	0.7	0.3	2.5	1.6	1.2	6.5	5.1	4.8	0.4	0.4	0.4
Southeast	2.8	2.0	1.7	0.2	0.4	0.2	2.0	1.8	1.2	6.2	4.0	2.6	0.7	0.7	0.7
Delta States	0.2	0.4	0.7	0.5	1.9	1.2	2.5	1.1	1.2	11.2	8.4	7.8	2.5	2.1	2.0
So. Plains	1.1	1.5	1.3	4.9	4.6	4.2	12.9	11.4	10.0	0.8	0.5	0.4	7.9	5.1	4.3
Mountain	1.0	1.0	0.9	0.7	0.6	0.5	11.8	10.0	10.3	-	-	-	0.7	0.5	0.4
Pacific	0.4	0.5	0.4	0.1	-	-	5.7	4.6	4.1	-	-	-	1.5	1.3	1.0
United States[2/]	74.5	75.1	69.1	13.7	16.7	13.5	80.6	64.7	60.9	66.2	61.6	59.8	13.8	10.3	8.9

- = None or fewer than 500,000 acres.

1/ Corn and sorghum for grain. All 1986 acreages based on harvest intentions. 2/ Includes the 48 conterminous States. Because of rounding, regional acres may not sum to U.S. totals.

Source: (14,16).

Table 7.--Cropland diverted from production under Federal farm programs, by region

Region	1969	1978	1982	1983	1984	1985	1986
	Million acres						
Northeast	1.5	0.2	0.1	1.0	0.1	0.2	0.5
Lake States	6.4	1.6	0.7	8.0	1.6	2.1	4.2
Corn Belt	13.0	2.8	1.2	17.9	2.8	3.8	9.0
No. Plains	15.4	6.9	3.7	20.9	9.4	10.1	14.3
Appalachian	3.5	0.3	0.1	2.6	0.4	0.5	1.5
Southeast	3.7	0.3	0.2	2.3	0.5	0.7	1.4
Delta States	1.0	0.2	0.6	3.5	1.3	1.9	2.5
So. Plains	7.8	3.4	2.3	12.8	5.7	5.9	7.4
Mountain	4.4	2.1	1.7	6.1	3.8	3.9	5.7
Pacific	1.2	0.5	0.6	2.9	1.2	1.6	2.4
United States[1/]	58.0	18.3	11.1	78.0	26.9	30.7	[2/]49.0
	Percent share of U.S. total[3/]						
Northeast	2.6	1.1	0.6	1.3	0.4	0.6	1.0
Lake States	11.0	8.9	6.4	10.3	5.8	6.7	8.5
Corn Belt	22.4	15.2	10.5	22.9	10.5	12.5	18.5
No. Plains	26.6	38.2	33.3	26.8	35.1	32.8	29.2
Appalachian	6.1	1.5	1.2	3.4	1.3	1.8	3.0
Southeast	6.3	1.7	1.4	2.9	1.9	2.3	2.8
Delta States	1.7	1.0	5.2	4.4	4.8	6.1	5.1
So. Plains	13.6	18.5	21.1	16.4	21.2	19.2	15.2
Mountain	7.6	11.4	15.1	7.8	14.3	12.8	11.7
Pacific	2.1	2.5	5.2	3.8	4.7	5.2	4.9
United States[1/]	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Includes the 48 conterminous States. Because of rounding, regional data may not sum to U.S. totals. 2/ Includes 3.8 million acres enrolled in 1986 in Conservation Reserve Program--3 million for the 1986 program and about 850,000 acres for 1987. 3/ Developed from unrounded estimates.

Source: (8).

in the Lake States, Corn Belt, and Northern Plains. Overall, U.S. soybean area was down by 6.4 million acres with largest declines in Appalachia, the Southeast, and the Delta States. More sorghum was harvested in these regions. Sorghum in 1986 covered 13.5 million acres, about the same as in 1981, even though producers placed 2.8 million base acres in 1986 acreage reduction programs. Nearly 5 million fewer acres of cotton were harvested in 1986 compared with 1981, and acreage was unchanged or lower in all regions, particularly the Southern Plains, where it was off by 3.6 million. U.S. producers diverted about 3.6 million acres of cotton base from production in 1986.

Farmers Divert 49 Million Acres

Cropland diverted from production under Federal programs totaled 49 million acres in 1986, 18.3 million above last year (table 7). Farmers entered into 10-year contracts to place 3.8 million acres in the Conservation Reserve Program (CRP), 3 million acres of which apply to the 1986 crop year (table 8). The rest was diverted under annual programs.

Participants in 1986 feed grain programs (corn, grain sorghum, barley, and oats) were required to idle 20 percent of their base acreages, compared with 10 percent in 1985 (5). Diverted feed grain acreage in 1986 totaled 19.3 million, 12.2 million above 1985. Producers in wheat programs were required to set aside 25 percent of their base acreage (30 percent in 1985), and those who planted before announcement of the 1986 program were eligible for land diversion payments on an additional 10 percent of their base acreage. Diverted wheat acres increased 2.1 million to 20.9 million in 1986. Participants in the upland cotton programs diverted 25 percent of their base acreage in 1986, down from last year's 30-percent requirement. Cotton acreage diverted in 1986 totaled 3.6 million acres, the same as in 1985.

The Northern Plains had 14.3 million diverted acres in 1986, 29 percent of the U.S. total. Second was the Corn Belt with 9 million acres, 18.5 percent of all diverted acreage. Corn and wheat acreage accounted for nearly 29 and 43 percent, respectively, of all diverted cropland in 1986 (table 8). Corn production is important in both regions. The Northern Plains is the principal wheat-producing area. Sizable acreages of cropland were also diverted in the Southern Plains (7.4 million) and the Mountain region (5.7 million) where wheat is the major crop.

The CRP began in 1986 with a goal of idling at least 5 million acres of highly erodible cropland, but only 3.8 million were enrolled. The 1987 goal is to increase

Table 8.--Base acreage diverted from production under Federal farm programs, United States

Crop	1969	1978	1982	1983	1984	1985	1986
				Million acres			
Corn	27.2	6.1	2.1	32.2	3.9	5.4	14.0
Grain sorghum	7.5	1.4	0.7	5.7	0.6	0.9	2.8
Barley	4.4	0.8	0.4	1.1	0.5	0.7	1.8
Oats			0.1	0.3	0.1	0.1	0.7
Wheat	11.1	9.6	5.8	30.0	18.6	18.8	20.9
Cotton		0.3	1.6	6.8	2.5	3.6	3.6
Rice			0.4	1.8	0.8	1.2	1.4
Long-term diversion	7.8						1/ 3.8
Total 2/	58.0	18.3	11.1	78.0	26.9	30.7	49.0

1/ Cropland idled for 10 years in the Conservation Reserve Program, of which 3 million acres are in the 1986 program and the rest in the 1987 one. An additional 5.1 million acres have been accepted for the 1987 program. 2/ Because of rounding, crop acreages may not sum to the totals.

Source: (8).

Table 9.--Acreage eligible for conservation reserve program (CRP) and acreage enrolled in 1986/87

Region	1986-87 program[1/]			Total eligible acres		
	Enrolled	Share of U.S. total[2/]	Percent of all cropland[3/]	Eligible	Share of U.S. total[2/]	Percent of all cropland[3/]
	Million acres	--------Percent--------		Million acres	-------Percent-------	
Northeast	*	0.5	0.2	2.3	3.4	13.5
Lake States	0.8	8.7	1.8	4.4	6.4	10.0
Corn Belt	0.9	9.9	1.0	16.2	23.3	17.5
Northern Plains	1.4	15.3	1.5	9.4	13.5	10.0
Appalachian	0.3	3.5	1.4	5.0	7.2	21.9
Southeast	0.5	5.5	2.7	2.4	3.5	13.4
Delta States	0.3	3.1	1.3	1.7	2.5	7.9
Southern Plains	1.6	17.7	3.5	12.9	18.6	28.8
Mountain	2.4	27.4	5.6	11.9	17.0	27.3
Pacific	0.7	8.4	3.3	3.2	4.6	14.2
United States[4/]	8.9	100.0	2.1	69.4	100.0	16.5

* = Fewer than 50,000 acres.
1/ Acres in 1985 CRP plus acres accepted for the 1987 CRP, as of 8/86. 2/ Developed from unrounded numbers. 3/ Enrolled and eligible acres as percentages of region's 1982 cropland acreage. 4/ Includes the 48 conterminous States.

Source: (17,18).

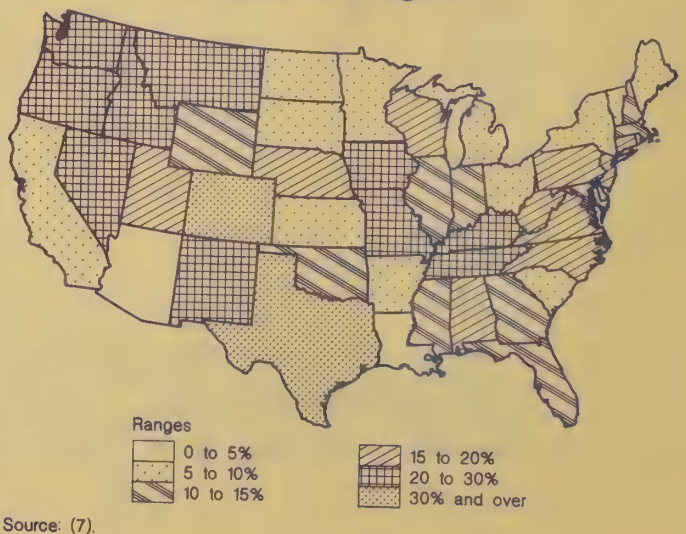
enrollment to a minimum of 15 million acres with 40-45 million acres in the program by 1990. In August, landowners submitted bids to enroll 6.4 million acres in the 1987 program. Bids were accepted for 5.1 million. Cropland in the CRP is idled for 10 years following enrollment, but the Secretary of Agriculture may modify or terminate a contract if the owner or operator agrees and if the action is in the public interest (5).

Landowners in the Mountain region have enrolled nearly 2.4 million acres in the CRP (table 9). This represents 27 percent of all CRP acreage but less than 6 percent of the region's cropland. Acreage is also relatively high in the Northern and Southern Plains regions, which together account for 3 million acres and one-third of the U.S. total. Enrolled acreage is lowest in the Northeast, Appalachian, and Delta regions.

Nearly 70 million acres of cropland--16.5 percent of all cropland as inventoried by the Soil Conservation Service (SCS) in 1982--have been identified as eligible for the CRP (table 9). The Corn Belt, with 16.2 million eligible acres--23 percent of the U.S. total--has the largest share. Sizable acreages are also located in the Southern Plains (12.9 million) and the Mountain region (11.9 million). Highly erodible cropland accounts for 29 percent of all cropland in the Southern Plains and 27 percent in the Mountain region.

The relationship between participation in the CRP and the distribution of eligible acres varies among regions. For example, the Corn Belt had 23 percent of all eligible acres but only 10 percent of the enrolled acres. In contrast, the Mountain region had 17 percent of the eligible acres but 27 percent of the program acres.

Figure 3
Percentages of Total Cropland Eligible for Conservation Reserve Program



Source: (7).

Conversions to Cropland Less Likely

The downward trend in cropland used for crops is projected to continue into 1990 as participation in acreage reduction programs increases, particularly in the longer-term CRP (11). But a reserve of land is available which is not subject to program restraints and has economic potential for conversion to crop use.

Within the cropland base, the area used only for pasture is routinely rotated between crops and pasture. In 1982, 65 million acres were in cropland pasture representing nearly 14 percent of all cropland (table 1). Part of this acreage is marginal for crop use and may remain in pasture indefinitely. With favorable cost-price relationships for crops, both absolutely and relative to livestock, much of this pasture could be readily converted to crop production. Also, a sizable acreage of pasture, range, and forestland was identified in 1982 as having high and medium potential for crop use (17).

Several provisions in the Food Security Act of 1985 are intended to discourage landowners from converting land to crop use. However, some landowners do not participate in farm programs. Target prices will be successively lowered during 1988-90 (5). Beginning in 1987, loan rates will be tied to an average of past market prices. The Secretary of Agriculture also has more discretion to lower loan rates.

Producers converting land to cropland (sodbusting) after December 23, 1985, are ineligible for certain USDA program benefits on all land they operate if the converted area is highly erodible and not farmed in accordance with an approved conservation system. Farmers who produced an agricultural commodity on highly erodible land at least 1 year during 1981-1985, have until January 1, 1990, or 2 years after the Soil Conservation Service (SCS) has completed a soil survey for the farm, to develop and begin actively applying an approved conservation plan. They have until January 1, 1995, to fully implement the plan.

The Wetland Conservation provision, commonly known as the "swampbuster" provision, denies eligibility for some USDA programs to farmers who converted wetlands after December 23, 1985, to produce agricultural commodities. Several exemptions to the swampbuster provisions exist, including the production of an agricultural commodity on wetlands that had been created artificially or on wetlands that dried through natural conditions such as drought.

The new "uniform acreage base" concept could also limit conversions to cropland. Beginning in 1987, the sum of crop acreage bases for wheat, feed grains, upland cotton, rice, soybeans, and normal idle acreage must equal the farm base. In subsequent years, a farmer can increase the acreage base for one crop by up to 10 percent only if one or more other cropland bases are reduced by an equivalent amount. But, the Secretary of Agriculture may suspend this limitation under certain market conditions.

Per-Acre Production At New High

Farmers have used cropland more intensively over time by increasing per-acre use of fertilizer and agricultural chemicals and by irrigating more acres. The index of crop production per acre in the United States rose to 119 in 1985, 7 points above the 1984 level (table 10). The previous high was 116 in 1982, but the index then dropped to 100 in 1983, a relatively dry year in several areas.

Several factors contributed to the rise in per-acre productivity, including technological and managerial improvements, more inputs applied to an acre of land, and changes in cropping patterns, such as double cropping.[5/] Additional use of supplemental irrigation and conservation tillage has increased the feasibility of double cropping, particularly in areas where length of growing season and the amount and distribution of precipitation limit cropping possibilities.[6/] After crops have been planted, changes in weather and growing conditions have less impact on intensity of cropland use, but generally have direct impacts on production outcomes and per-acre productivity. In years with cropland diversion programs, participants have generally idled their least productive land and increased input use on land in production, thereby raising per-acre productivity on remaining cropland.

5/ Inputs use is discussed in (9). 6/ The use of supplemental irrigation and conservation tillage is discussed in later sections of this report.

Table 10.--Indices of crop production per acre of cropland used for crops by region

Year	North-east	Lake States	Corn Belt	Northern Plains	Appa-lachian	South-east	Delta States	Southern Plains	Mountain	Pacific	United States 1/
					1977 = 100						
1969	109	86	93	84	114	113	101	80	92	87	91
1974	106	78	77	77	108	125	100	77	98	97	88
1978	109	102	108	110	109	114	100	88	109	95	105
1979	109	105	116	119	102	120	112	109	107	107	113
1980	104	100	102	92	95	102	81	79	111	113	100
1981	112	106	114	116	118	130	110	106	117	112	115
1982	114	114	117	120	120	133	118	91	116	115	116
1983	104	101	88	102	88	116	98	97	110	114	100
1984	117	110	105	118	116	129	118	100	107	121	112
1985 2/	120	114	124	129	111	134	114	106	103	119	119

1/ Includes the 48 conterminous States. 2/ Preliminary.

Source: (10).

Several regions also experienced index highs in 1985--the Northeast (120), Corn Belt (124), Northern Plains (129), and Southeast (134). Indexes were higher for all regions, except the Appalachian (down 5 points), Delta (down 4), Mountain (down 4), and Pacific (down 2). Lower values were largely due to dry conditions.

Acreage Equivalents of Crops Exported Lowest Since 1971

U.S. agricultural exports for fiscal 1986 are forecast to be down 13-15 percent from last year's 126 million tons and more than 34 percent below the 1980 peak. U.S. and world stocks of major commodities are at record or near-record levels. Without a dramatic upturn in world demand, all exporters will be facing an increasingly competitive market and downward pressure on world prices. U.S. farmers look to export markets for disposing of a significant portion of domestic production and, in turn, for strengthening domestic prices. Because the demand for most commodities is inelastic, changes in the volume of commodities exported can have substantial impacts on world and domestic prices.

The acreage equivalent of U.S. crops exported in fiscal 1985 was 87 million acres, 9 million below the 1984 level. The 1985 level was the lowest since 1971, the year just prior to the expansion of export markets in the 1970's (table 11). The peak was 137 million acres in 1980, 50 million above the 1986 level.

Acreage equivalents are derived by dividing export volumes of individual commodities during the fiscal year by respective per-acre yields. In 1985, for example, the volume of food grains exported during October 1984 through September 1985 divided by respective 1985 yields for these crops resulted in a combined equivalent of 30 million acres. Oil crops accounted for a 27-million-acre equivalent and feed grains 19 million acres.

Figure 4

Acreage Equivalents of Crops Exported, United States

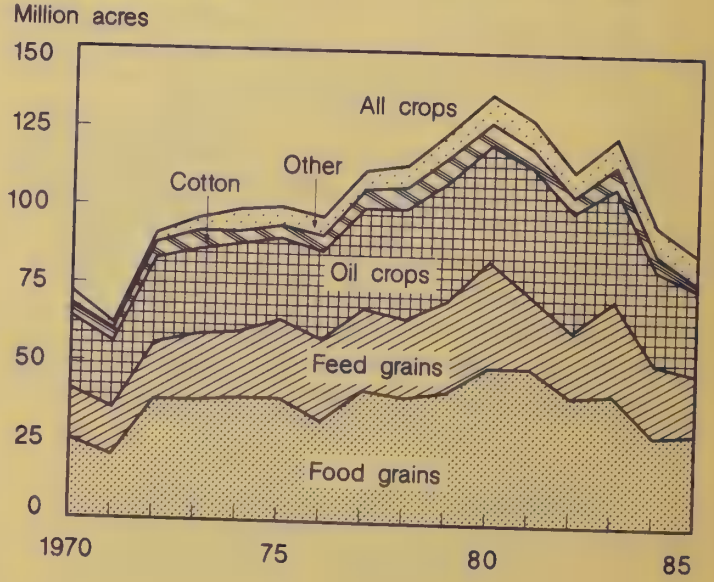


Table 11.--Acreage equivalents of U.S. crops exported, 1970-85

Year	All crops harvested[2/]	Used for exports[1/]					
		Total	Food grains	Feed grains	Oil crops	Cotton	Other crops
	Million acres						
1970	293	72	25	16	23	4	4
1971	305	62	20	15	21	4	2
1972	294	91	38	18	27	5	3
1973	321	96	38	21	27	6	4
1974	328	99	39	21	28	4	7
1975	336	100	39	25	26	4	6
1976	337	97	32	26	28	5	6
1977	345	112	42	26	32	6	6
1978	338	114	40	25	35	7	7
1979	348	125	42	29	38	8	8
1980	352	137	50	34	37	7	9
1981	366	129	50	23	41	6	9
1982	362	113	41	21	38	5	8
1983	306	124	42	30	36	7	9
1984	348	96	29	23	30	5	9
1985	343	87	30	19	27	2	9
	Percent exported[3/]	Percent of total acreage equivalents					
1970	25	100	35	22	32	6	5
1971	20	100	32	24	34	7	3
1972	31	100	42	20	30	5	3
1973	30	100	40	22	28	6	4
1974	30	100	40	21	28	4	7
1975	30	100	39	25	26	4	6
1976	29	100	33	27	29	5	6
1977	32	100	38	23	29	5	5
1978	34	100	35	22	31	6	6
1979	36	100	34	23	31	6	6
1980	39	100	36	25	27	5	7
1981	35	100	39	18	32	4	7
1982	31	100	36	19	34	4	7
1983	41	100	34	24	29	6	7
1984	28	100	30	24	31	5	10
1985	25	100	35	22	31	2	10

1/ In terms of fiscal years. 2/ Includes all cropland harvested plus acres double cropped. 3/ Acreage equivalents of exports as a percent of all crops harvested.

Source: (10,12).

The 1985 export acreage equivalents represented 25 percent of all crops harvested. This was down from 28 percent in 1984 and 39 percent in 1980. About 35 percent of the 1985 acreage equivalents was accounted for by food grains, 22 percent by feed grains, 31 percent by oil crops, 2 percent by cotton, and 10 percent by other crops. These percentages have varied over the years but without much trend (fig. 4). In recent years, cotton exports have been less important while other crops, including tobacco, have earned larger shares of the export total.

The Food Security Act of 1985 includes several provisions designed to make the United States more competitive in world markets (5). Loan rates for wheat and feed grains are lowered to encourage exports and to reflect domestic and international market conditions. Loan levels may be further reduced from the basic rate by up to 20 percent if such a reduction is necessary to maintain domestic and export markets. The legislation also mandates several export promotion programs and other measures to expand the volume of U.S. exports.

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WATER

Nearly 45 Million Acres Are Irrigated

About 43 million acres of cropland and 1.5 million acres of pasture and rangeland were irrigated in 1984 (table 12). This nearly 45-million-acre total was 10 percent below the alltime peak of 50.3 million acres in 1978.

Since 1978, depressed commodity prices and rising energy costs have reduced the demand for irrigation in much of the country. By 1982, irrigated acres had dropped to 49 million, and by 1984, they had dropped another 9 percent. Data for 1985 and 1986 are not yet available, but since petroleum-based energy costs have dropped, the nation's irrigated acreage may be holding at around the 1984 level.

Twenty States Have Most of the Irrigation

The nation's irrigated lands--94 percent of the total in 1984--were concentrated in 17 western and 3 southeastern States, hereafter called the 20 principal States (table 12). California had the most irrigated land (7.8

Table 12.--Irrigated land and water application, by States, 1984 1/

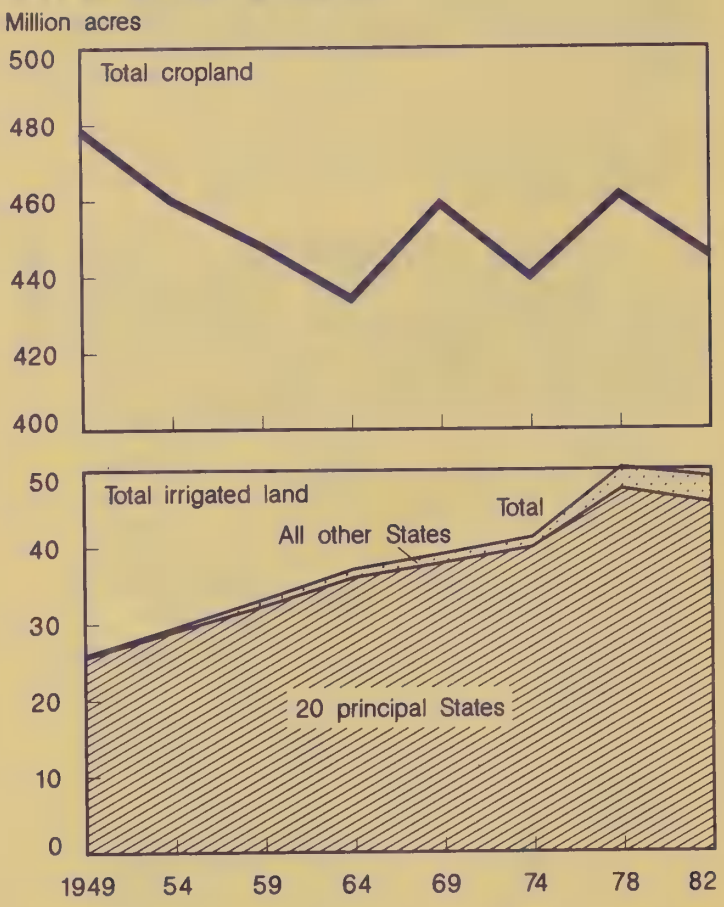
State and region	Cropland			Other pasture and rangeland	Total	Water applied per acre
	Harvested	Pasture	Other cropland 2/			
	1,000 acres					acre feet
Southeast and Delta						
Arkansas	1,855	2	15	*	1,872	1.41
Florida	1,229	54	32	124	1,438	1.92
Louisiana	578	*	*	*	579	1.68
Northern Plains						
Kansas	2,256	16	25	18	2,315	1.36
Nebraska	5,703	49	23	52	5,828	1.08
North Dakota	142	*	1	*	144	1.05
South Dakota	330	3	6	*	339	0.92
Southern Plains						
Oklahoma	414	13	9	3	440	1.38
Texas	4,674	149	54	45	4,921	1.38
Mountain						
Arizona	803	52	35	4	893	4.38
Colorado	2,732	251	8	114	3,105	1.65
Idaho	2,737	330	43	144	3,255	1.75
Montana	1,414	257	16	190	1,877	1.83
Nevada	519	77	6	96	698	2.61
New Mexico	598	55	14	8	674	2.23
Utah	853	146	4	52	1,054	2.14
Wyoming	1,187	189	7	167	1,550	1.65
Pacific						
California	7,176	303	38	288	7,805	3.06
Oregon	1,284	299	26	167	1,776	2.00
Washington	1,364	86	9	24	1,482	2.17
20 Principal States	37,849	2,332	371	1,495	42,046	1.92
All other States	2,671	3	10	1	2,685	0.78
United States	40,520	2,335	381	1,496	44,731	1.85

* Fewer than 500 acres. 1/ Only those acres actually receiving irrigation are reported. This is less than the number of acres which have the potential to be irrigated in any given year. The number of irrigated acres may vary not only with investments in new or improved irrigation facilities, but with the level of use of current facilities. During wet years, the number of acres reporting irrigation, especially those receiving water only as a supplement to naturally occurring precipitation, would tend to decline. 2/ Includes soil improvement crops, failed acres, summer fallow, idled acres, and cropland planted but to be harvested after the census year.

Source: (2).

Figure 5

Growth Trends in Irrigated Land and Total Cropland, 1949-1982



Source: (2).

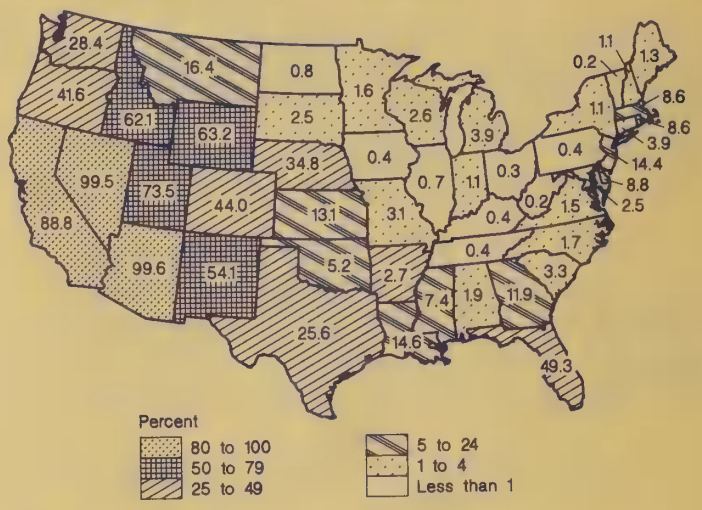
million acres), followed by Nebraska (5.8 million), Texas (4.9 million), and Idaho (3.3 million).

Some of the principal States had major proportions of harvested cropland under irrigation (figure 6). Arizona and Nevada each had over 90 percent of harvested cropland under irrigation. California, Utah, Idaho, Wyoming, and New Mexico each had over half of their harvested cropland acres under irrigation.

Rates of application of irrigation water are also highest in the arid West where most crop water needs have to be met by irrigation. Irrigators in Arizona applied an average of 4.4 acre feet of water per irrigated acre in 1984 (table 12). Application rates were also high in California (3.06 acre feet/acre), Nevada, New Mexico, and Washington. Rates were much lower in humid areas where irrigation is used to supplement normal rainfall.

Figure 6

Harvested Irrigated Cropland as a Percent of Total Harvested Cropland, 1982



Source: (2).

Irrigation Is Increasing in Some Areas

The overall national drop in irrigated acreage masks regional differences in irrigation trends. Total irrigated acreage among the minor irrigated States grew from 1.4 million in 1974 to over 2.8 million in 1978, and then to 3.4 million in 1982. In contrast, irrigated acreage in the principal irrigated States rose from 39.9 million in 1974 to 47.5 million in 1978, then fell to 45.6 million in 1982. The number of acres under irrigation increased between 1978 and 1982 in 24 States, mainly in the East. In the West, irrigated acreage increased in Nebraska, North Dakota, and South Dakota but declined elsewhere (1).

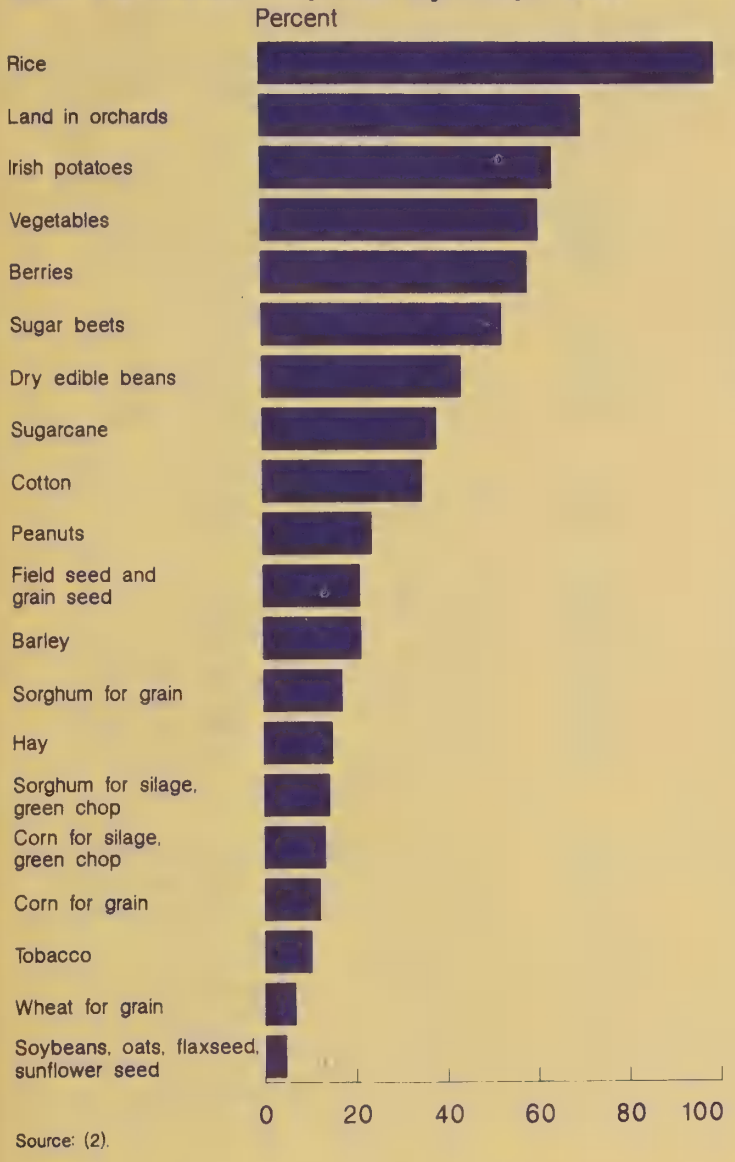
In parts of the humid East, supplemental irrigation has been expanding rapidly as farmers attempt to increase returns per acre and reduce weather risks. Rainfall in the East is usually sufficient for crop production, but periodic local moisture shortages affect production, and infrequent severe droughts, like the ones in 1983 and 1986, can be catastrophic for producers. Supplemental irrigation in the East is expected to increase further.

Rice Is The Most Irrigated Crop

Most major crops grown in the United States receive at least some irrigation, but the importance of irrigation varies among crops and production regions. All rice acreage was

Figure 7

Harvested Irrigated Cropland as a Percent of Total Harvested Cropland, by Crop, 1982



Source: (2).

irrigated in 1982 (Figure 7). Just over 70 percent of land in orchards was also irrigated. The proportion was over 50 percent for vegetables, potatoes, and sugarbeets. For cotton the proportion was about 35 percent. In contrast, only 12 percent of the corn for grain, 7 percent of the wheat, and 4 percent of the soybean acreage was irrigated.

Irrigation Contributes Greatly to Farm Output

Average yields for irrigated crops are significantly higher than dryland crop yields (table 13). In the 20 principal States, the differences in crop yields on irrigated and nonirrigated lands range from about 25 percent on some types of hay to over 100 percent for corn, wheat, and barley.

Based on 1982 data, the most recent available, irrigated farms comprised about 12 percent of all farms and produced nearly one-third of the total value of agricultural products sold off the farm (table 14). The proportion of the value of agricultural products sold that is accounted for by irrigated farms is highest in the Pacific and Mountain regions--78 percent and 64 percent, respectively. In California, the U.S. leader in value of farm products sold, irrigated farms produced over 82 percent of the State's total agricultural products sold off the farm. In 13 States, production on irrigated farms accounted for more than 50 percent of the value of agricultural products sold.

Table 13.--Average yields per acre on irrigated and nonirrigated lands on irrigated farms, 1984

Crop	Unit	20 principal States		All other States 1/		United States average 1/	
		Irrigated	Nonirrigated	Irrigated	Nonirrigated	Irrigated	Nonirrigated
Corn for grain	bu	137	68	140	102	137	89
Corn for silage	ton	21	14	18	12	21	13
Sorghum	bu	93	51	93	53	100	79
Wheat	bu	69	35	43	42	69	35
Barley	bu	81	39	61	56	81	40
Soybeans	bu	36	26	38	27	36	27
Other beans	cwt	21	16	16	15	20	15
Rice	cwt	55	NA	47	NA	55	NA
Alfalfa	ton	4.4	2.5	4.8	3.7	4.4	2.7
Other hay	ton	1.9	1.5	2.3	1.9	1.9	1.6
Cotton	lb	833	446	947	716	837	500
Sugar beets	ton	23	NA	19	19	23	19
Tobacco	lb	2529	NA	2307	1930	2322	1930
Potatoes	cwt	333	171	306	228	328	219

1/ Excluding Alaska and Hawaii.

Source: (2).

Table 14.--Irrigated farms and value of agricultural products sold by irrigated farms, 1982.

State and Region	Farms			Value of agricultural products sold		
	Irrigated farms 1/	All farms	Percent irrigated	Sold by all farms	Sold by irrigated farms	Percent 2/
				Million dollars		
Southeast and Delta						
Arkansas	6,678	50,525	13	2,826	1,069	38
Florida	10,550	36,352	29	3,522	2,488	71
Louisiana	3,693	31,628	12	1,406	411	29
Northern Plains						
Kansas	7,257	73,315	10	6,191	1,843	30
Nebraska	22,190	60,243	37	6,626	4,125	62
North Dakota	762	36,431	2	2,294	103	4
South Dakota	1,815	37,148	5	2,478	334	13
Southern Plains						
Oklahoma	3,069	72,523	4	2,530	372	15
Texas	19,775	185,020	11	8,936	2,912	33
Mountain						
Arizona	4,437	7,334	60	1,527	1,067	70
Colorado	15,232	27,111	56	2,941	1,718	58
Idaho	17,355	24,714	70	2,232	1,763	79
Montana	9,226	23,570	39	1,547	695	45
Nevada	2,154	2,719	79	203	184	91
New Mexico	6,918	13,484	51	851	419	49
Utah	11,174	13,984	80	555	440	79
Wyoming	5,284	8,861	60	606	427	70
Pacific						
California	58,389	82,463	71	12,491	10,271	82
Oregon	15,334	34,087	45	1,641	1,184	72
Washington	16,252	36,080	45	2,831	1,755	62
20 Principal States	237,544	857,592	28	64,235	33,579	52
All other States	40,733	1,383,384	3	67,665	6,135	9
United States	278,277	2,240,976	12	131,900	39,714	30

1/ Irrigated farms are those with any agricultural land irrigated in the specified calendar year. 2/ Percent of total sold by irrigated farms.

Source: (1)

Irrigation Methods and Water Sources Vary By Area

Ground and Surface Water Equally Used

Irrigators obtained about half of their water supplies from ground water and about half from surface water sources in 1984. Small quantities of reclaimed effluent, primarily from municipal waste treatment facilities, were also used.

On-farm ground water pumping facilities provided 44 percent of irrigation water supplies. Another 12 percent came from on-farm surface water supplies, and the remaining 44 percent was delivered by off-farm suppliers, such as irrigation districts and private water companies (table 15).

The 20 principal States use more surface water than ground water, 57 percent versus 43 percent, respectively. In the other States, about 75 percent of the water is ground water and 25 percent is from surface supplies.

Nearly half the water used by the 20 principal States came from off-farm sources. Especially in the West, use of off-farm water supplies is common because naturally occurring water supplies are more variable and scattered than in the East. Substantial public or cooperative private investments have been

Table 15.--Irrigation water by source of supply and State, 1984.

State and region	On-farm ground water		On-farm surface water		Off-farm sources		Total	
	Acres 1/	Acre-feet	Acres 1/	Acre-feet	Acres 1/	Acre-feet	Acres 1/	Acre-feet
	1,000							
Southeast and Delta								
Arkansas	1,666	2,306	215	316	12	24	1,894	2,646
Florida	789	1,084	182	290	477	1,385	1,449	2,760
Louisiana	394	623	180	316	18	35	591	974
Northern Plains								
Kansas	2,139	2,902	46	50	138	188	2,372	3,139
Nebraska	5,019	5,209	163	117	692	960	5,874	6,286
North Dakota	80	73	33	31	31	47	144	151
South Dakota	131	94	88	86	120	132	339	312
Southern Plains								
Oklahoma	364	521	31	29	45	56	440	606
Texas	4,012	4,883	223	493	699	1,393	4,934	6,769
Mountain								
Arizona	524	2,138	23	97	375	1,676	922	3,912
Colorado	1,398	1,945	427	704	1,436	2,482	3,261	5,131
Idaho	1,060	1,593	284	425	1,959	3,667	3,303	5,685
Montana	56	73	767	1,760	1,083	1,601	1,906	3,434
Nevada	175	467	254	584	277	773	706	1,825
New Mexico	442	916	39	50	221	531	702	1,506
Utah	123	276	104	223	833	1,760	1,060	2,259
Wyoming	85	135	631	909	843	1,519	1,559	2,563
Pacific								
California	3,113	8,187	685	1,688	4,621	14,046	8,419	23,921
Oregon	366	579	629	1,259	803	1,723	1,798	3,561
Washington	398	684	164	350	943	2,181	1,505	3,215
20 principal States	22,335	34,688	5,168	9,786	15,626	36,180	43,178	80,654
All other States	1,952	1,556	719	489	221	41	2,892	2,086
United States 2/	24,287	36,244	5,887	10,276	15,847	36,220	46,070	82,740

1/ Estimates include some duplicate reporting of acreage irrigated by water supplies from more than one source. 2/ Includes the 48 conterminous States.

Source: (2).

made in the western States for collecting, storing, and transporting surface water.

In many areas of the West where surface water supplies could not be developed or were inadequate to meet irrigators' demands, ground water has become an increasingly important source of irrigation water. Until recently, the increase in ground water use was concentrated in the plains area from Texas through Nebraska, with the most rapid growth occurring in Nebraska. Other States, such as Florida and Georgia, are also expanding their use of ground water for irrigation.

Gravity Flow Systems Are the Most Common

As water supplies become increasingly scarce and expensive, new and more efficient irrigation technologies are being adopted. However, gravity flow systems are still common, serving 60 percent of the irrigated acreage nationwide in 1984 (table 16). Among the 20 principal States, gravity systems served 63 percent of the acreage, sprinkler systems 34 percent, and other systems 3 percent. In the other States, sprinkler systems served 79 percent of the land and gravity flow systems only 19 percent. Gravity systems are less

Table 16.--Irrigated lands by method of irrigation by State, 1984 1/

State and region	Sprinkler	Gravity	Drip or trickle	Sub-irrigation	All systems
			1,000 acres		
Southeast and Delta					
Arkansas	160	1,727	2	10	1,899
Florida	395	620	220	245	1,480
Louisiana	87	504	0	1	592
Northern Plains					
Kansas	950	1,391	1	0	2,342
Nebraska	2,988	2,814	0	80	5,882
North Dakota	100	44	0	0	144
South Dakota	226	113	1	0	340
Southern Plains					
Oklahoma	239	212	1	0	453
Texas	1,367	3,669	20	0	5,056
Mountain					
Arizona	74	776	51	0	901
Colorado	1,110	2,082	4	14	3,210
Idaho	1,739	1,533	4	31	3,308
Montana	565	1,298	0	64	1,928
Nevada	123	567	0	13	703
New Mexico	222	455	3	5	685
Utah	296	739	14	9	1,058
Wyoming	188	1,360	0	21	1,568
Pacific					
California	1,902	5,774	450	88	8,213
Oregon	856	907	12	29	1,804
Washington	1,140	349	15	1	1,504
20 principal States	14,724	26,935	797	612	43,069
All other States	2,153	522	40	11	2,726
United States 2/	16,877	27,457	838	623	45,795

1/ Estimates include some duplicate reporting of acreage irrigated by type of system. 2/ Includes the 48 conterminous States.

Source: (2).

common in the East because of hilly farmland. Also, much of the irrigation water applied on eastern farms comes from ground water pumped to the surface and easily routed through a pressurized system.

References

1. U.S. Department of Commerce, Bureau of the Census. Census of Agriculture, Census Years 1949–1982.

2. U.S. Department of Commerce, Bureau of the Census. 1984 Farm and Ranch Irrigation Survey. AG84–SR–1, Special Report Series. 1986.

SOIL CONSERVATION

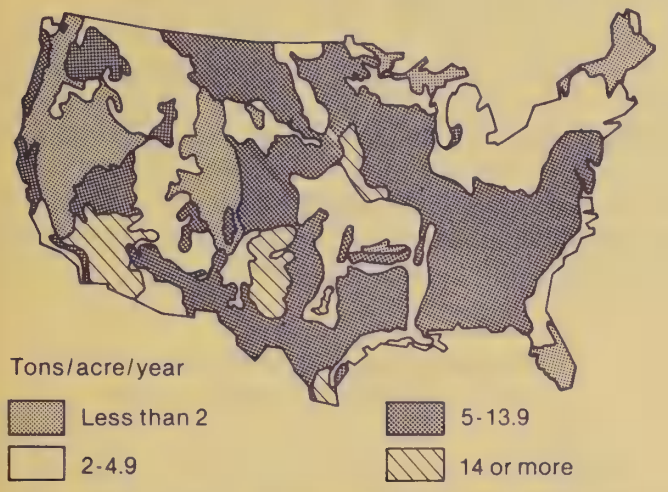
Cropland Erosion Causes Substantial Damage

Soil erosion has received more public attention during the past decade than since the Dust Bowl years of the 1930's, partly because of better documentation of its impacts and costs. Particular attention has focused on the effects of converting "highly" erodible soils from permanent vegetation to crop cultivation. Estimated annual erosion on all U.S. cropland in 1982 was as follows (9,21):

Types of erosion	Billion tons	Tons per acre	Percent of total
Sheet and rill erosion	1.84	4.4	60
Wind erosion	1.25	3.0	40
Total measured	3.09	7.4	100

Figure 8

Average Annual Cropland Erosion, 1982



Includes sheet, rill, and wind erosion on cropland.
Source: (19).

Wind erosion estimates are less reliable than sheet and rill estimates because of difficulties of measurement. No recent estimates exist of gully and ephemeral erosion. Of the estimated sheet and rill erosion of 1.8 billion tons, approximately 40 percent--720 million tons---were carried by rainfall and irrigation runoff into the Nation's waterways (1).

Erosion of cropland varies according to cropping pattern, slope, soil, climate, and conservation practices. High erosion rates occur frequently in all areas of the country, but are particularly pervasive in the Corn Belt and Plains regions (figure 8).

Erosion Reduces Productivity

U.S. cropland is classified into four erosion tolerance categories based on actual rates of sheet, rill, and wind erosion, as follows (21):

	Acreage		Erosion	
Actual erosion rate in 1982	Million acres	Percent of total	Billion tons	Percent of total
Below tolerance (T) level	222	53	.46	15
Between T and 2T	95	23	.57	18
Between 2T and 3T	34	8	.40	13
Over 3T	70	16	1.66	54
Total U.S. cropland	421	100	3.09	100

The tolerance (T) value indicates the annual erosion rate above which long term yield prospects or productivity may be reduced (see terms used, page 2). For cropland, this T value varies from 1 to 5 tons per acre per year depending upon soil conditions. Under 1982 cropping conditions and practices, nearly 200 million acres (47 percent of total cropland) are eroding above T. However, erosion and productivity loss are most serious for that one-quarter of total cropland eroding above 2 T, and particularly for the 16 percent of cropland eroding above 3 T. The latter category alone accounts for over half of the total tons of eroded soil and a high portion of the future productivity loss.

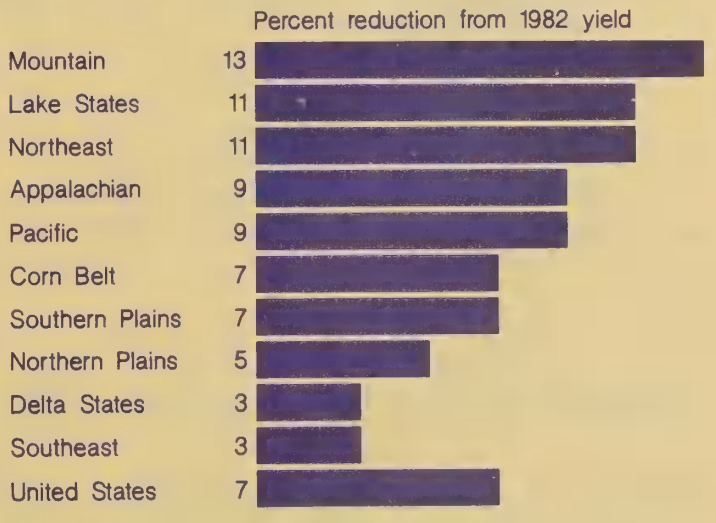
Long-term (100 year) productivity losses can be measured by estimating future yield reductions as a percent of current yields, assuming continuation of current erosion rates and technology (figure 9). The average yield loss over the next 100 years for the Nation would be about 7 percent. Relatively high yield losses, on average, are estimated for the Mountain, Northeast, and Lake States regions, and low losses for the Southeast and Delta States.

Productivity losses due to erosion also may cause farmers to apply more inputs to maintain yields, raising production costs. Total cost of long-term yield losses and increased inputs due to sheet, rill, and wind erosion on cultivated cropland eroding above T has been estimated at $771 million (3).

Eroded soil may be deposited on the farm itself, hindering plant growth, filling ponds and

Figure 9

Estimated 100-Year Productivity Losses from Sheet, Rill, and Wind Erosion



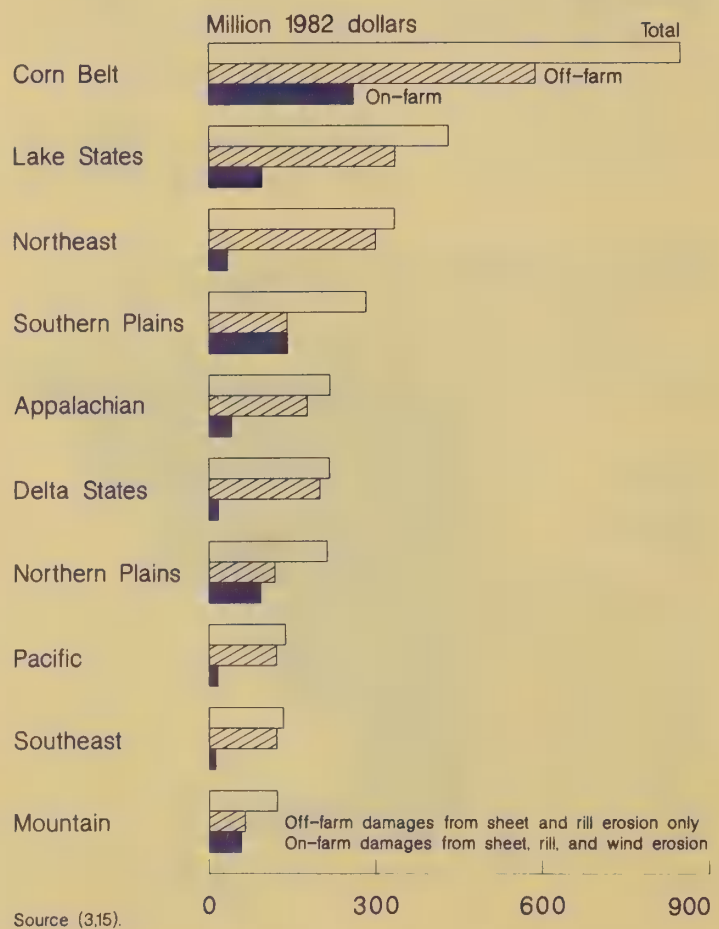
Source: (21).

ditches, and increasing the costs of sediment removal. No comprehensive estimates of these on-farm costs has been made (10), but the dollar value is probably lower than the productivity damages.

Off-farm Damages of Erosion Exceed On-farm

Off-farm damage caused by cropland sediment and nutrients moving into water bodies has been estimated to range between $1.2 and $4.7 billion nationally, with a single value estimate of $2.2 billion (2). The major off-farm damages are diminished water-based recreation, increased flood damage, reduced water storage capacity, and higher maintenance costs of harbors and waterways. National estimates of off-farm damage caused by wind erosion of cropland have not been published, but may be of similar magnitude to that for water (13). Even if the off-farm wind erosion damage is lower than the water erosion damage, total off-farm damage appears substantially greater than the on-farm damage.

Figure 10
Regional Damage from Cropland Erosion, 1982



Source (3,15).

Regional comparisons of these on-farm, off-farm, and total damages from cropland erosion are shown in figure 10. The on-farm damages include wind erosion, but the off-farm damages do not because of lack of data. Highest off-farm and total damages are in the Corn Belt and Lake States. Lowest damages occur in the Southeast and Mountain regions. The addition of off-farm wind erosion damage could substantially increase the off-farm and total damage estimates for the Plains and Mountain regions.

Conservation Expenditures and Programs Are Changing

National expenditures for land and water conservation by farmers, landowners, and State, local, and Federal (largely USDA) agencies totaled about $2.1 billion in fiscal 1984, the latest year for which data are available (11). 7/ Of this total, private expenditures for conservation were just over $900 million (43 percent). Public expenditures totaled $1.2 billion (57 percent), with USDA accounting for nearly $1.0 billion.

USDA land and water conservation expenditures were $895 million in fiscal 1985 and are estimated at $925 million in 1986 (table 17), just under 2 percent of the total USDA budget. However these expenditures for conservation were only four-fifths as large as those in 1979. About 42 percent, or $384 million, of the estimated 1986 expenditure is for soil erosion control, up from 31 percent and $354 million in 1979. This increase in the share of the USDA conservation budget over the 7-year period occurred at the expense of other conservation activities.

Future appropriations for USDA conservation programs in general, and soil erosion control in particular, are uncertain in the current situation of fiscal austerity. The President's proposed budget for fiscal 1987 would reduce total funding for ongoing USDA conservation programs to almost one-half the 1985 level. This proposed cutback could be offset by separate funding for the new conservation programs established by the Food Security Act of 1985.

7/ Dollar expenditures in this section have been converted in 1982 dollars to facilitate comparison.

Table 17--USDA land and water conservation and erosion control expenditures from appropriations, fiscal years 1979, and 1985-87 1/

Activities and programs 2/	All conservation expenditures				Soil erosion control			
	1979 actual	1985 actual	1986 estimated	1987 proposed	1979 actual	1985 actual	1986 estimated	1987 proposed
	Millions of 1982 dollars 3/							
A. Onfarm technical assistance and extension	246.6	266.9	263.0	253.1	121.3	133.6	115.0	127.6
Conservation technical assistance (SCS)	225.3	245.6	242.1	240.8	114.9	127.7	109.2	125.2
Extension information and education (ES)	14.5	14.2	13.9	5.6	6.2	5.8	5.7	2.3
Cooperative forestry management (FS)	6.8	7.1	7.0	6.7	0.2	0.1	0.1	0.1
B. Onfarm installation cost-sharing	354.4	242.4	236.4	0.0	161.7	170.0	165.9	0.0
Agricultural conservation program (ASCS)	259.4	178.6	174.4	0.0	111.6	135.7	132.5	0.0
Conservation administration (ASCS)	38.8	23.4	22.8	0.0	16.7	14.8	14.4	0.0
Forest incentives program (ASCS)	18.4	11.8	11.4	0.0	18.4	11.8	11.4	0.0
Water bank program (ASCS)	10.5	8.3	8.0	0.0	0.0	0.0	0.0	0.0
Great Plains conservation program (SCS)	27.3	20.3	19.8	0.0	15.0	7.7	7.6	0.0
C. Project conservation programs	339.0	205.8	245.2	77.5	10.1	24.3	28.2	9.3
Watershed and flood prevention (SCS)	306.4	181.1	221.1	67.2	6.2	18.1	22.2	6.7
Resource conservation & development (SCS)	32.6	24.7	24.1	10.3	3.9	6.2	6.0	2.6
D. Subtotal for implementation (A + B + C)	940.0	715.1	744.6	330.6	293.1	327.9	309.1	136.9
E. Conservation research and development (FS, ARS, CSRS, ERS)	93.2	99.5	101.2	96.2	21.6	34.2	34.5	31.3
F. Data collection and analysis (SCS)	95.1	80.3	79.6	68.5	38.9	41.0	40.2	34.9
Total distributed expenditures (D + E + F) 4/	1,128.3	894.9	925.4	495.3	353.6	403.1	383.8	203.1
--Relative to 1985 expenditures (%)	126	100	103	55	88	100	95	50
--Share for erosion control (%)	31	45	42	41	—	—		—

1/ Source: (12). Current dollar estimates from Budget of the U.S. Government for Fiscal Year 1987 (Appendix), supplemented with data from the 1980 RCA report and later RCA data from USDA. About 90 percent of all actual USDA conservation expenditures for 1985 are given in the FY 1987 budget. Erosion control expenditures are not in the official budget but are estimated from erosion control percentages given for individual USDA programs in RCA reports. Such percentages are assumed to remain substantially unchanged between 1985 and 1987. 2/ Reponsible USDA agencies, in parentheses: SCS--Soil Conservation Service; ES--Extension Service; FS--Forest Service; ASCS--Agricultural Stabilization and Conservation Service; ARS--Agricultural Research Service; CSRS--Cooperative State Research Service; and ERS--Economic Research Service. 3/ Current-dollar estimates converted to 1982 dollars using implicit price deflators for nondefense Federal government personnel compensation for categories A, E, and F. Implicit price deflators for Federal purchases of conservation and development structures used for categories B and C. Deflators generally from the Survey of Current Business, Vol. 66, No. 7 (July 1986), Vol. 61, No. 7 (July 1981), and intervening July issues of the Survey. 4/ Includes those programmed and nonrepayable expenditures that can be allocated among soil erosion control, water conservation, urban, wildlife, and other resource concerns. Not included are all loan programs of FMHA and emergency conservation programs of ASCS.

Some Ongoing Conservation Programs Face Cuts

Most ongoing Federal conservation programs have their origin in the Soil Conservation and Domestic Allotment Act of 1935. This Act authorized financial and technical assistance for implementing conservation on private lands. Ongoing programs for implementing conservation are divided into three types: on-farm technical assistance and extension, on-farm installation cost sharing, and project conservation (table 17).

The on-farm technical assistance and installation cost-share programs go hand in hand and account for 54 percent of USDA conservation expenditures in 1986. Over half the expenditures in these two categories go toward erosion control, with the balance for other conservation activities. The Soil Conservation Service (SCS) program accounts for the bulk of the technical assistance category expenditures, and The Agricultural Stabilization and Conservation Service (ASCS) accounts for most of the installation cost-share expenditures.

The President's proposed budget for fiscal 1987 maintains funding for SCS technical assistance programs, but cuts funding for ASCS on-farm installation cost-share programs. Offsetting proposed cuts in ongoing cost-share programs will be separate funding through the Commodity Credit Corporation (CCC) for cost-sharing the establishment of protective cover as called for in the new Conservation Reserve Program (6) (see next section).

A recent ERS nationwide analysis compared 1983 program benefits with costs of USDA cropland erosion control programs (17). The findings suggest that:

- Soil conservation programs are more cost effective when they are focused on highly erodible land. Past programs directed a significant

part of the conservation assistance to cropland eroding at less than 5 tons per acre per year. Recent efforts are more directed toward critical erosion areas. The ERS analysis suggests that the benefits of erosion control exceed the costs involved only on land eroding at about 15 tons per acre per year and above.

- The economic efficiency of conservation programs would increase if off-site benefits of erosion control were given more recognition in directing programs. Off-site benefits may account for two-thirds of total erosion control benefits.

- Conservation assistance should be based on the economic value of soil productivity loss and the value of reducing off-site damages rather than simply on physical erosion rates. These values differ among soils and across geographic areas.

The ERS analysis supports a growing recognition that targeting of soil conservation assistance to critical areas would prevent more erosion with the same dollars (14). Results of the experimental Model Implementation Program, the Rural Clean Water Program, and partial targeting initiated by USDA point in the same direction. The new conservation provisions of the 1985 Food Security Act aimed at highly erodible lands further reflect the targeting trend.

New Programs Targeted to Highly Erodible Lands 8/

The new farm bill--the Food Secuirty Act of 1985--includes major conservation provisions aimed at reducing crop production and erosion on highly erodible lands and wetlands (6,18). The provisions include the Conservation Reserve Program and the conservation compliance, sodbuster, and swampbuster requirements. Roughly 25 percent of all cropland could be affected.

8/ This section was prepared by Mike Dicks, Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture.

The Conservation Reserve Program (CRP) offers farmers annual rental payments and one-time cost sharing (one-half the cost) for establishing a permanent cover on highly erodible cropland. Currently, eligibility is limited to about 70 million acres of cropland with a current erosion rate of at least three times the soil loss tolerance (T) level. Enrollment in the CRP is for 10 years. No more than 25 percent of the cropland acreage in any county may generally be enrolled, and only those fields in which at least two-thirds of the cropland is highly erodible.

Through August 1986, 8.9 million acres were enrolled in the CRP, with the Northern and Southern Plains and Mountain States providing the greatest participation (table 9). The goals of the program are to have 15 million acres in the program by 1987 and 40 million or more by 1990. Rental payments to farmers in the first three signups ranged up to $90 per acre on accepted bids, with a national average of $46 for the 8.9 million acres enrolled. The estimated average rate of erosion reduction is about 24 tons per acre per year (TAY), ranging from 46 TAY in the Southern Plains to 17 TAY in the Northeast.

In contrast to the monetary incentives provided by the CRP, the conservation compliance, sodbuster, and swampbuster provisions curtail eligibility for certain Government program benefits if conservation requirements are not met. Curtailed benefits are commodity price support loans, purchases, and payments for program crops, including farm storage facility loans and storage payments of CCC-owned commodities; loans made, insured or guaranteed by the Farmers Home Administration; Federal crop insurance; and disaster payments.

Conservation compliance requires farmers with highly erodible cropland to begin implementing by 1990 a conservation plan approved by the conservation district and to complete implementation by 1995. "Highly erodible" for both conservation compliance and sodbuster refers to potential erosion rather than actual erosion, the criterion used for the CRP. While 118 million acres of U.S. cropland are potentially highly erodible, the conservation compliance provision will affect only about 84 million acres. The other 34

million are currently eroding at less than the tolerance level and are considered in compliance.

An approved conservation plan prescribes measures to reduce the rate of erosion to the tolerance (T) level (see terms used, page 2). However, if the local conservation district in consultation with the farmer determines that it is "impracticable" to reduce erosion to T, practices must be installed to reduce erosion to a level not exceeding twice the T value. This exception was provided because of problems in accurately measuring and reducing erosion in areas such as the Great Plains and Mountain States where wind is the dominant cause of erosion.

The sodbuster provision denies eligibility for Government program benefits to farmers converting erodible rangelands and forestlands to cultivated cropland without implementing a district-approved conservation plan. As a portion of the highly erodible land converted to cropland in recent years required commodity support payments to be farmed profitably, the sodbuster provision should deter future conversions induced by price expectations (7). Also, the sodbuster provision should discourage reconversion of CRP lands to crop production when CRP contracts expire.

The swampbuster provision denies eligibility for Government program benefits to farmers converting wetlands to cropland. The 1982 National Resources Inventory (NRI) identified about 60 million acres of privately held wetlands. Although approximately 42 million of these acres could be converted to cropland, conversion would be profitiable on only about 5 million (8). Since conversion of any wetland on a farm makes the entire farm ineligible for Government program benefits, this provision should be a strong deterrent.

Conservation Tillage Is the Dominant Practice

Conservation practices are the means by which erosion is reduced or controlled. These practices range from management practices involving tillage, cropping, or improved irrigation up to practices that involve structures such as terraces, diversions, and grassed waterways. Sometimes erosion on highly erodible cropland can be reduced to the

Table 18--Cropland acres in selected conservation practices and percentage of new acres receiving government cost sharing assistance, 1983.

Practice	Total acres with the practice	New acres as a percent of total	Percentage of new acres receiving goverment cost sharing assistance
	Million	Percent	Percent
No-till	11	15	22
Other conservation tillage	51	5	8
Total conservation tillage	62	7	14
Contouring	18	1	37
Strip cropping	18	5	5
Cover and green manure crops	13	58	4
Grassed waterways	4	5	71
Terraces 1/	22	4	75
Water and sediment diversion 1/	3	10	45

Source: (20).
1/ Acres benefited by practice.

tolerance (T) level only by putting the land into permanent grass or other cover, as is taking place under the new Conservation Reserve Program.

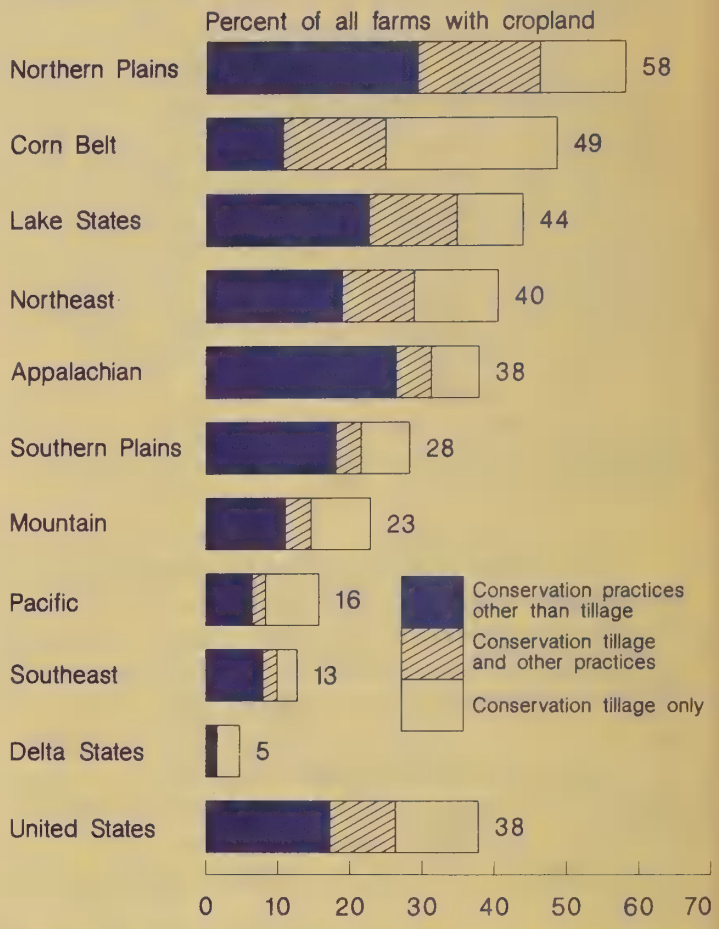
Conservation tillage has become the single most used soil conservation practice on cropland, except for possibly conservative cropping (rotation) systems for which data are not available. In 1983, over 62 million acres of cropland were in conservation tillage (table 18). In contrast, only 3 to 22 million acres were treated or benefited by other selected conservation practices. The dominance of conservation tillage was probably even greater in 1985, when the practice was reportedly used on nearly 100 million acres, or about 30 percent of planted cropland (4). Some of this acreage, however, likely did not have the required minimum residue cover to be technically called conservation tillage (5).

Some of the cropland acres treated or benefited by the various conservation practices were newly treated in 1983, ranging from 1 percent of the acreage under contouring up to 58 percent of the land in cover or green manure crops (table 18). New acres in conservation tillage were 7 percent of the total acres in this practice, but the proportion was much higher for no-till than for other types of the practice.

Government cost-sharing assistance was more frequent on expensive structural practices such as terraces, grassed waterways, and water and sediment diversions (table 18). Only 14 percent of all new conservation tillage acres in 1983 received Government cost-sharing, however, the percentage was nearly three times higher for no-till than for other forms of the practice.

Regional variations in the extent of conservation use by farmers partly reflect local differences in the need for conservation practices. Percentages of farmers using one or more of seven selected conservation practices (same as those listed table 18) were highest in the Northern Plains, Corn Belt, Lake States, and Northeast (figure 11). Lowest use levels occurred in the southern and western areas of the country. This pattern held for both conservation tillage and other selected practices (as a group) with one major exception. The Corn Belt had the highest use

Figure 11
Farms with Selected Conservation Practices, 1983



Conservation practices other than tillage include contouring, strip cropping, cover or green manure crops, grassed-waterways, terraces, and water and sediment diversions.
Source (16).

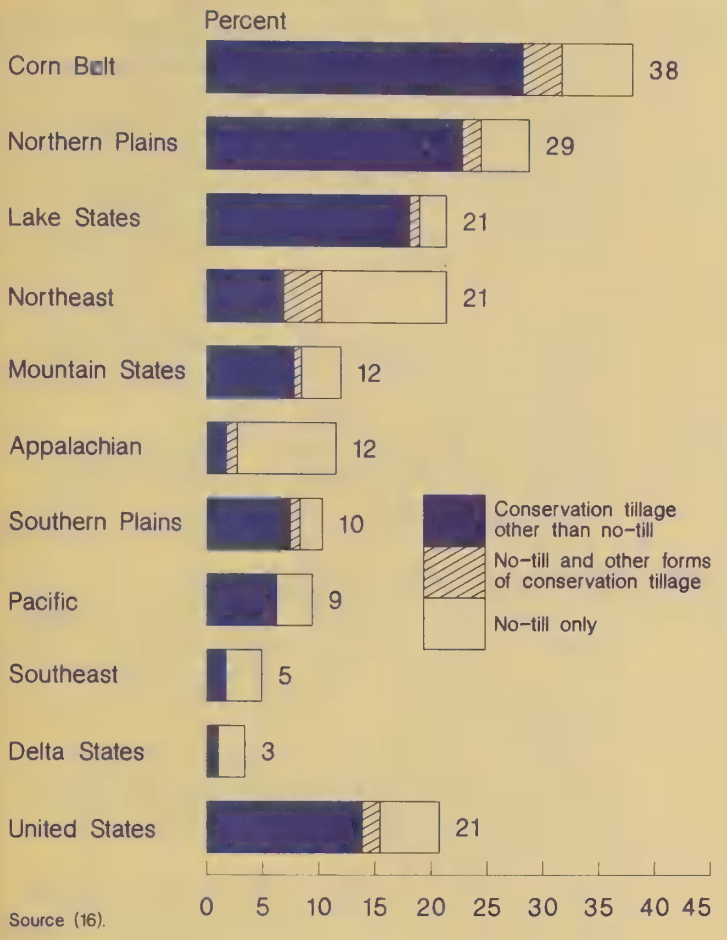
of conservation tillage, but use of other selected conservation practices was lower than four other regions.

Several types of conservation tillage were practiced. Nationally, 7 percent of all farmers used no-till and 16 percent used other types, including 2 percent who used both (figure 12). The use of no-till was highest in the Northeast (15 percent of all farms) while use of other types of conservation tillage was highest in the Corn Belt (32 percent of farms). The lowest use of conservation tillage, less than 5 percent, occurred in the Delta and Southeast (16).

Farmers use conservation tillage for reasons other than erosion control. Over one-third of the land under conservation tillage inventoried in 1982 had no need for the practice to protect productivity (21). Besides reducing erosion, conservation tillage conserves moisture, and in many cases, saves

Figure 12

Farms Using Conservation Tillage as a Percent of All Farms with Cropland, 1983



Source (16).

time in getting crops planted and reduces tillage costs (5). In 1983, about one-fifth of conservation tillage farmers said time and cost savings were more important reasons for using the practice than were soil and water conservation (16). Another 50 percent said time and cost savings were as important as conservation.

The major crops under conservation tillage in 1985 were small grains (wheat, oats, and barley) and full season corn and soybeans, which accounted for 85 percent of total acreage in conservation tillage (table 19). For each of these three groups of crops, conservation tilled acres made up 30-38 percent of those planted to that crop. High proportions of double cropped soybeans, sorghum, and corn were produced using conservation tillage.

Medium to large farms have been more prone to adopt conservation practices than have those with under 100 acres of cropland. This relationship was more pronounced for

Table 19--Crops under conservation tillage (CT) 1985.

Crop	Percent of U.S. acres in CT	CT as a percent of total acres in crop
Small grain	35	35
Corn (full season)	32	38
Soybeans (full season)	18	30
Sorghum (full season)	6	32
Soybeans (double crop)	4	60
Sorghum (double crop)	1	54
Corn (double crop)	1	47
Other crops	3	10
Total	100	31

Source: (4).

conservation tillage than for other practices and generally occurred in most regions of the country (21).

Conservation Tillage in Future Affected by Many Factors

The use of conservation tillage has increased consistently over the past 20 years, except during 1983 when 78 million cropland acres were diverted to noncrop use under the Payment-in-Kind and other acreage adjustment programs. Among the factors encouraging past growth were steeply rising energy costs from 1978 to 1981 and the more pervasive cost-price squeeze that farmers have faced in recent years. Because conservation tillage requires less fuel than conventional tillage, it offered a way to reduce production costs while maintaining yields. Adopting the practice, however, usually requires the purchase or rental of special machinery. New planters, sprayers, and other equipment may be needed.

Will the use of conservation tillage continue to expand in coming years? This will be determined by a range of economic factors. Further expansion may be encouraged by the following conditions:

1. The practice is the most cost-effective way for many farmers with highly erodible cropland to reduce erosion to levels required for Government program eligibility under the Conservation Compliance Provision of the 1985 Food Security Act.

2. The prospect of continued low cropland values and slowly declining commodity program benefits suggest that land will be used more extensively for crop production. Conservation tillage is consistent with a land–extensive approach.

3. Previous adopters of conservation tillage are likely to continue to capitalize on their managerial and capital investments in the practice.

4. The practice reduces total tillage and planting time compared with conventional methods, which is particularly advantageous to farmers double cropping.

Other factors, however, are likely to limit adoption of conservation tillage. These include:

1. Crude oil prices have fallen precipitiously during the past year and farm energy prices are expected to remain low over the next few years. Farmers may see less need for the adoption of energy–saving practices such as conservation tillage.

2. Recent declines in farm asset values have reduced the availability of farm credit. A large portion of indebted farmers may be unable to finance the purchase of the special equipment needed for adoption of conservation tillage.

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LIST OF TABLES

IMPACTS OF EROSION CONTROL ON FARM INCOME

by

John Putman and Klaus Alt 1/

Abstract: If farmers maximize profit with no Government inducements to conserve soil, they will expand the adoption of conservation tillage. Even with that potential expansion, erosion-caused yield losses would reduce income on 88.6 million erodible acres by 4 percent over the next 100 years. Limiting erosion to 2T (twice the erosion tolerance level) would drop income 9.5 percent from the 1982 level, as lower returns due to greater use of rotations to meet the limit offset the benefits of curbing yield losses caused by erosion. Limiting erosion to 2T and 1T would reduce income by $250 million and $1.1 billion, respectively, below the maximum profit level.

Key words: Erosion damages, soil erosion, agricultural productivity, conservation tillage, farm income.

What is the optimum level of soil conservation? This analysis sheds partial light on the question by comparing the net value of crop production (income) obtained from the Nation's most erodible land, assuming different levels of sheet and rill erosion control.

Erosion decreases soil productivity by reducing the thickness of the topsoil and the ability of the soil to hold moisture, by changing texture and chemical properties of the plow layer, removing nutrients and organic matter, changing toxicity in the root zone, and accelerating water runoff. Thus, the soil's profit potential may be reduced by a combination of lower crop yields, greater fertilizer and other chemical requirements, and higher tillage costs.

To measure the resulting economic losses to the Nation, we (1) identified cropland with high potential sheet and rill erosion and the crops grown on that land, (2) estimated the most profitable way of producing that crop mix, assuming no erosion control and no Government intervention (our base scenario), and (3) determined the most profitable way of producing those crops if sheet and rill erosion were restricted first to 2T (twice the soil's erosion tolerance level) and then to 1T (the level at which no damage to productivity would occur).

1/ Agricultural Economists, Natural Resource Economics Division, Economic Research Service.

Note the limitations of our analysis:

- It considers only on-farm erosion impacts. Off-site benefits of erosion control, believed to exceed on-farm benefits, would have to be included to fully assess the optimum level of soil conservation.
- We consider only sheet and rill erosion. The impacts of wind, gully, and ephemeral erosion, though important, have not been sufficiently quantified to permit their inclusion in the analysis.
- We treated the 88.6 million acres of erodible land independently of other non-erodible or less erodible cropland acres. In reality, the reduction in crop acres on the erodible cropland to meet 2T and 1T erosion limits would be partially offset by expansion of production on other cropland. Because income losses to the owners of erodible land may be partially recouped by income gains elsewhere, our estimate of social income loss would be overstated.

Cropland with the highest potential erosion was defined as land that would erode faster than T if the crops grown on it were spring-plowed and no conservation practices followed. The Soil Conservation Service's National Resource Inventory (NRI) in 1982

Table 1.--Regional distribution of erodible land in this study

Crop production region	Million acres	Percent of region's cropland
Northeast	8.5	49
Lake States	5.4	12
Corn Belt	26.2	28
Northern Plains	14.0	15
Appalachian	11.6	51
Southeast	7.2	40
Delta States	3.0	14
Southern Plains	4.7	10
Mountain	3.5	8
Pacific	4.7	21
United States	88.6	21

gave us estimated acres in erodible groups.2/ To identify the acres in those land groups that would erode over tolerance if spring-plowed and without soil conservation, we used data on production methods and accompanying erosion rates developed for the Center for Agricultural and Rural Development (CARD) at Iowa State University. Some 88.6 million acres were identified (table 1). They comprised over 90 percent of the Nation's cropland that would erode above the tolerance level if it were spring-plowed.

We estimated yields, costs, and expected erosion on these 88.6 million acres (differentiated in 4 soil groups and 168 regions) for each of five tillage and conservation methods:

- o Spring-plow tillage.
- o Spring-plow tillage with contouring.
- o Conservation tillage.
- o Conservation tillage with contouring.
- o Conservation tillage with terraces.

Erosion and crop yield estimates were derived from EPIC, the Erosion-Productivity Impact Calculator (4). EPIC simulates physical relationships between weather, hydrology, erosion, plant nutrients, plant growth, soil characteristics, and tillage operations. It simulates daily occurrences for over 100 years to measure the relatively slow process of change due to erosion.

Production costs were based on tillage budgets prepared by Soil Conservation Service State staffs and processed by CARD (1). Gross income was estimated by multiplying crop yields, derived from EPIC, times "normalized prices," weighted by cropped acres reported in the 1982 NRI (3).3/

A spreadsheet analysis indicated the most profitable acreage-tillage mix, assuming no restrictions on erosion and no Government intervention. To derive the most profitable base scenario, we selected the tillage and conservation combination with the highest revenue on each soil in each region, assuming the actual 1982 cropping pattern. Under this scenario, 10.7 million of the 88.6 million erodible acres would be tilled as straight-row spring-plowed, 57.0 million would be in straight-row conservation tillage, 3.9 million contoured but spring-plowed, and 17.0 million contoured with conservation tillage.

Conservation tillage is the most profitable option on the vast majority of soils and is therefore adopted on 74.0 of the 88.6 million acres. But even with extensive use of the practice, EPIC results over the next 100 years show that erosion-caused yield losses would depress income by 4.2 percent below the 1982 figure (table 2). This would be economically equivalent to taking 3.9 million acres out of production. The largest income loss would occur in the Corn Belt where, in effect, production from 1.5 million acres would be lost. The Delta States would suffer the highest relative loss (8.1 percent).

What happens to income from the land if erosion is restricted? We recognized that land which could not remain in row crops and still

2/ The land groups were those based on the SCS Land Capability Class System (LCC) and used for the Department's 1985 Appraisal required in the 1977 Soil and Water Resources Conservation Act, as follows: Group 2, LCC IIe land; Group 3, LCC IIIe; Group 4, LCC IVe; and Group 8, all LCC V to VIII.

3/ "Normalized prices" are commodity price estimates computed annually by ERS and used by the Federal Government to plan and evaluate potential long-term resource development projects. These prices reflect potential market prices in the absence of abnormal factors such as drought or sudden shifts in export demand.

Table 2.--Decrease in income on 88.6 million erodible acres 1/

Farm production region	Maximum-profit scenario		2T limit		1T limit	
	Percent	Million acres	Percent	Million acres	Percent	Million acres
Northeast	3.0	.3	9.6	.8	12.0	1.0
Lake States	1.9	.1	2.0	.1	3.3	.2
Corn Belt	5.9	1.5	11.3	3.1	12.7	3.5
Northern Plains	2.0	.3	4.3	.6	5.6	.8
Appalachian	6.0	.7	12.9	1.6	15.8	1.9
Southeast	2.8	.4	10.8	.8	20.7	1.6
Delta States	8.1	.3	20.0	.7	22.9	.8
Southern Plains	2.7	.1	15.2	.5	22.6	.8
Mountain	.2	* 2/	1.2	*	1.7	.1
Pacific	*	*	*	*	1.8	.1
U.S. total 3/	4.2	3.9	9.5	8.4	12.1	10.8

1/ Acre loss is computed from EPIC simulations as the summation of percent loss of total product in 100 years times total acres. 2/ Less than .05 percent or less than .05 million acres 3/ Numbers may not sum due to rounding.

meet the 2T or 1T limits would be converted to less intensive rotations that include more hay and pasture, and that the effects of those shifts on income would vary from field to field. For this analysis we assumed that conversion of the most erodible cropland group to pasture would reduce income from that land by 50 percent. For less erodible cropland groups we assumed that one-half of the crop rotation would be in hay and pasture, with an assumed total income loss of only 25 percent.4/

Table 2 shows that income would drop 9.5 percent if erosion were limited to 2T, and 12.1 percent if limited to 1T. These losses would be equivalent to taking 8.4 million acres out of production in the 2T case, and 10.8 million if erosion were limited to 1T. Notice the substantial loss in the Corn Belt due to substitution of relatively low profit rotations for a sizable acreage of high profit but erosive crops.

Income losses that occur when erosion is limited to 2T are the result of two factors: land use shifts to less profitable rotations and yield losses caused by erosion. While limiting erosion reduces yield losses, the reduction in income due to increased use of rotations more than offsets the economic benefits of preventing yield losses. In the 2T scenario, 10.2 million acres shift to less intensive rotations, with an assumed 25 percent loss in income. Another 6.1 million are converted to permanent grass, incurring a 50 percent income loss.

Under the 1T scenario, 29.8 million acres shift to less intensive rotations and 6.9 million acres are converted to permanent grass. All acres remaining in the original crops are conservation tilled or contoured, with 29.8 million acres both contoured and conservation tilled. Table 2 shows that the reduction in income under the 1T scenario exceeds the reduction of the other two scenarios. As yield losses equal zero under the 1T scenario, all of these losses are due to increased use of rotations to meet the 1T limit.

Table 3 compares reductions from income under the maximum profit scenario when erosion is limited to 2T and 1T. Meeting the 2T limit would reduce income an average of $250 million per year, or a loss of $6 billion over the next 100 years.5/ The loss in the Corn Belt would account for half of the reduction for the United States, although the region has only 30 percent of the erodible

4/ These assumptions are supported by data which show pasture cash rents across regions ranging from 35 to 58 percent of those for cropland (2).

5/ This loss is the net present value of the 100-year stream of annual losses discounted at 4 percent.

Table 3.--Income changes measured from maximum profit base

Farm production region	Erodible acres	2T scenario Ave. annual	2T scenario Net present worth	1T scenario Ave. annual	1T scenario Net present worth
	Million acres	Million dollars			
Northeast	8.5	33	819	132	3,310
Lake States	5.4	25	607	61	1,530
Corn Belt	26.2	126	3,080	508	12,705
Northern Plains	14.0	15	368	80	1,994
Appalachian	11.6	26	645	155	3,881
Southeast	7.2	19	456	135	3,386
Delta States	3.0	9	212	56	1,403
Southern Plains	4.7	0	0	5	88
Mountain	3.5	0	0	0	0
Pacific	4.7	0	0	2	44
U.S. total	88.6	250	6,187	1,156	28,340

cropland included in the analysis. Substantial losses would also occur in the Northeast, Appalachia, and Northern Plains. The same regional pattern holds for the 1T limit, but the total income loss in that case would jump to $1.1 billion per year, or $28.3 billion for 100 years.

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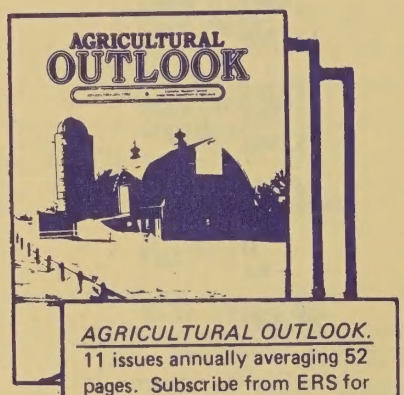

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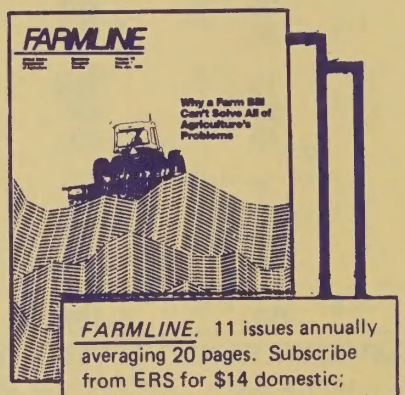

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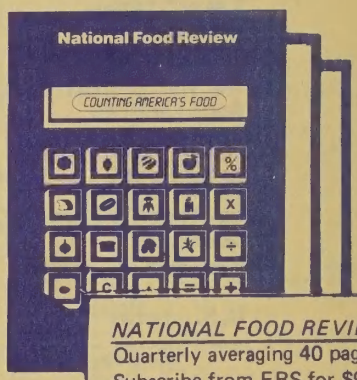

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